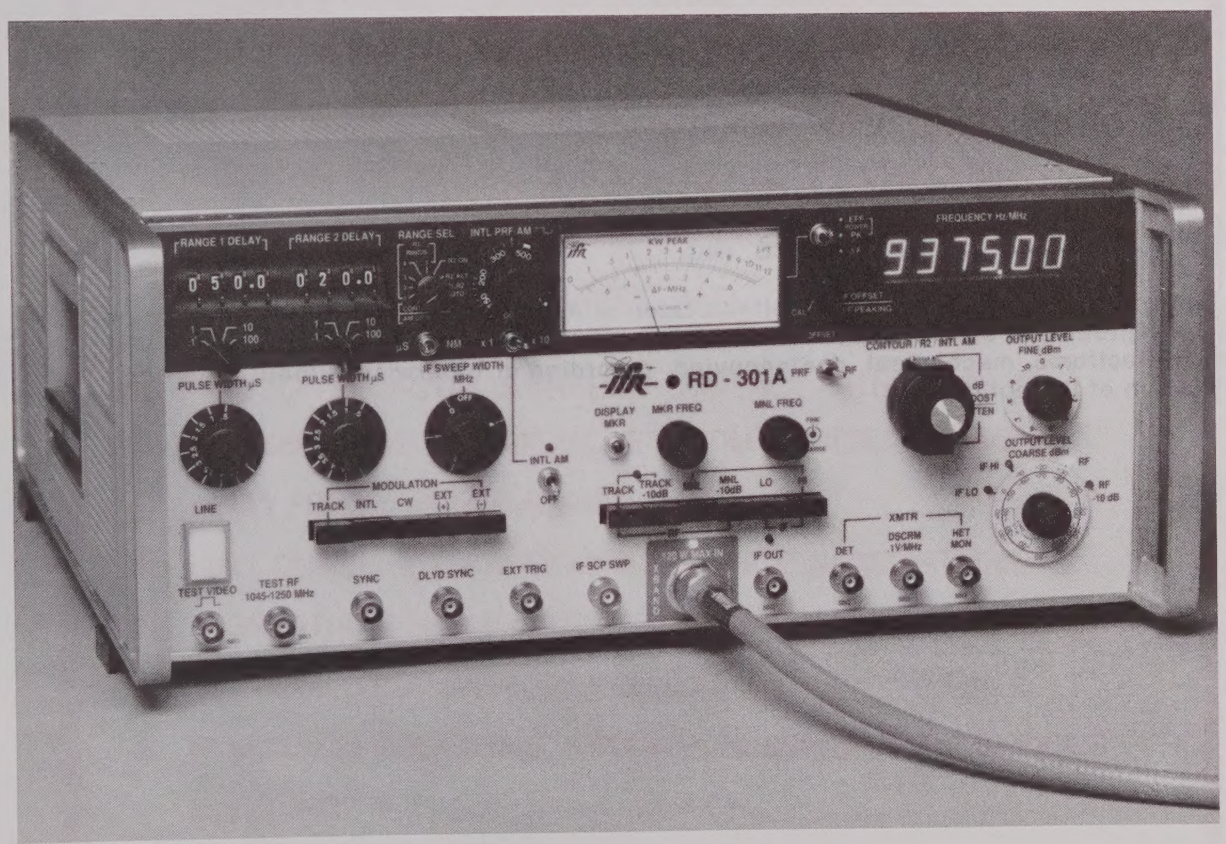
OPERATION MANUAL

SYSTEMS, INC.

RD - 301A
RADAR TEST SET

OPERATION MANUAL

RD - 301A
RADAR TEST SET



10200 West York Street / Wichita, Kansas 67215 U.S.A. / (316) 522-4981 / TWX 910-741-6952

1002-9001-200

OPERATION MANUAL
RD-301A

PUBLISHED BY
IFR SYSTEMS, INC.
Wichita, Kansas

COPYRIGHT © 1992 by IFR SYSTEMS, INC.

All rights reserved. Printed in the United States of America. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the publisher.

WARNING

HIGH VOLTAGE EQUIPMENT

THIS EQUIPMENT CONTAINS CERTAIN CIRCUITS AND/OR COMPONENTS OF EXTREMELY HIGH VOLTAGE POTENTIALS, CAPABLE OF CAUSING SERIOUS BODILY INJURY OR DEATH. WHEN PERFORMING ANY OF THE PROCEDURES CONTAINED IN THIS MANUAL, HEED ALL APPLICABLE SAFETY PRECAUTIONS.

RESCUE OF SHOCK VICTIMS

1. DO NOT ATTEMPT TO PULL OR GRAB THE VICTIM.
2. IF POSSIBLE, TURN OFF THE ELECTRICAL POWER.
3. IF YOU CANNOT TURN OFF ELECTRICAL POWER, PUSH, PULL OR LIFT THE VICTIM TO SAFETY USING A WOODEN POLE, ROPE OR SOME OTHER DRY INSULATING MATERIAL.

FIRST AID

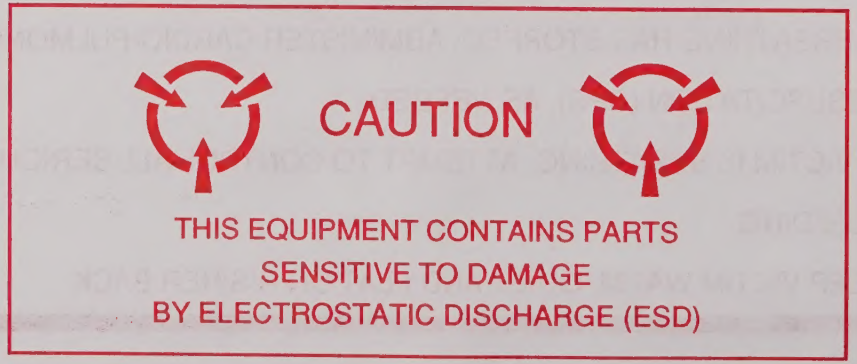
1. AS SOON AS VICTIM IS FREE OF CONTACT WITH SOURCE OF ELECTRICAL SHOCK, MOVE VICTIM A SHORT DISTANCE AWAY FROM SHOCK HAZARD.
2. CALL FOR DOCTOR AND/OR AMBULANCE, IMMEDIATELY.
3. IF BREATHING HAS STOPPED; ADMINISTER CARDIO-PULMONARY RESUSCITATION (CPR), AS NEEDED.
4. IF VICTIM IS BREATHING, ATTEMPT TO CONTROL ALL SERIOUS BLEEDING.
5. KEEP VICTIM WARM, QUIET AND FLAT ON HIS/HER BACK.

CAUTION: INTEGRATED CIRCUITS AND SOLID STATE DEVICES SUCH AS MOS FETS, ESPECIALLY CMOS TYPES, ARE SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGES RECEIVED FROM IMPROPER HANDLING, THE USE OF UNGROUNDED TOOLS AND IMPROPER STORAGE AND PACKAGING. ANY MAINTENANCE TO THIS UNIT MUST BE PERFORMED WITH THE FOLLOWING PRECAUTIONS:

- BEFORE USE IN A CIRCUIT, KEEP ALL LEADS SHORTED TOGETHER EITHER BY THE USE OF VENDOR-SUPPLIED SHORTING SPRINGS OR BY INSERTING LEADS INTO A CONDUCTIVE MATERIAL.
- WHEN REMOVING DEVICES FROM THEIR CONTAINERS, GROUND THE HAND BEING USED WITH A CONDUCTIVE WRISTBAND.
- TIPS OF SOLDERING IRONS AND/OR ANY TOOLS USED MUST BE GROUNDED.
- DEVICES MUST NEVER BE INSERTED INTO NOR REMOVED FROM CIRCUITS WITH POWER ON.
- PC BOARDS, WHEN TAKEN OUT OF THE SET, MUST BE LAID ON A GROUNDED CONDUCTIVE MAT OR STORED IN A CONDUCTIVE STORAGE BAG. REMOVE ANY BUILT-IN POWER SOURCE, SUCH AS A BATTERY, BEFORE LAYING PC BOARDS ON A CONDUCTIVE MAT OR STORING IN A CONDUCTIVE BAG.
- PC BOARDS, IF BEING SHIPPED TO THE FACTORY FOR REPAIR, MUST BE PACKAGED IN A CONDUCTIVE BAG AND PLACED IN A WELL-CUSHIONED SHIPPING CONTAINER.

CAUTION: THE USE OF SIGNAL GENERATORS FOR MAINTENANCE AND OTHER ACTIVITIES CAN BE A SOURCE OF ELECTROMAGNETIC INTERFERENCE TO AVIATION RECEIVERS, WHICH CAN CAUSE DISRUPTION AND INTERFERENCE TO AERONAUTICAL SERVICE OUT TO A DISTANCE OF SEVERAL MILES.

CAUTION: USERS OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION WHICH RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND ENSURE COMPLIANCE WITH INSTRUCTIONS IN FAA CIRCULAR AC 170-6C, DATED FEBRUARY 19, 1981.



RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY

THIS PAGE INTENTIONALLY LEFT BLANK.

LIST OF EFFECTIVE PAGES

Chapter/Section/Subject	Page	Date
Title Page		Mar 1/92
Copyright Page		Mar 1/92
Warning Page		Mar 1/92
Caution Page		Mar 1/92
Record of Revisions Page		Mar 1/92
List of Effective Pages	1 through 2	Mar 1/92
Table of Contents	1 through 2	Mar 1/92
Introduction	1 through 2	Mar 1/92
1-Table of Contents	1 through 2	Mar 1/92
1-List of Illustrations	1 through 2	Mar 1/92
1-List of Tables	1 through 2	Mar 1/92
1-1-1	1 through 2	Mar 1/92
1-2-1	1 through 4	Mar 1/92
1-2-2	1 through 14	Mar 1/92
1-2-3	1 through 16	Mar 1/92
1-2-4	1 through 20	Mar 1/92
1-3-1	1 through 6	Mar 1/92
1-4-1	1 through 2	Mar 1/92
1-5-1	1 through 2	Mar 1/92
Appendix A	1 through 2	Mar 1/92
Appendix B	1 through 2	Mar 1/92
Appendix C	1 through 2	Mar 1/92
Appendix D	1 through 2	Mar 1/92
Index	1 through 4	Mar 1/92

THIS PAGE INTENTIONALLY LEFT BLANK.

TABLE OF CONTENTS

Title	Chapter/Section
Title Page	
Copyright Page	
Caution Page	
Warning Page	
Record of Revisions	
List of Effective Pages	
Table of Contents	
Introduction	
Chapter 1	
Description	1-1
Operation	1-2
Specifications	1-3
Shipping	1-4
Storage	1-5
Appendix A - Connector Pin-Out Table	
Appendix B - Test Equipment Requirements	
Appendix C - Metric/British Imperial Conversion Table With Nautical Distance Conversions	
Appendix D - Abbreviations	
Index	

THIS PAGE INTENTIONALLY LEFT BLANK.

INTRODUCTION - RD-301A RADAR TEST SET

This manual contains the information necessary to install, operate and evaluate the RD-301A Radar Test Set.

It is strongly recommended that personnel be thoroughly familiar with the contents of this manual before attempting to operate this equipment.

NOMENCLATURE

In this manual, the RD-301A Radar Test Set is also referred to as Test Set, RD-301A or RD-301A Test Set.

ORGANIZATION

This manual is divided into five sections:

CHAPTER 1 - OPERATION

- Section 1 - DESCRIPTION (physical and mechanical description of RD-301A)
- Section 2 - OPERATION (installation; description of controls, connectors and indicators; performance evaluation; general operating procedures)
- Section 3 - SPECIFICATIONS
- Section 4 - SHIPPING
- Section 5 - STORAGE

THIS PAGE INTENTIONALLY LEFT BLANK.

CHAPTER ONE

RD-301A RADAR TEST SET

OPERATION MANUAL

TABLE OF CONTENTS

Title	Chapter/Section/Subject	Page
SECTION 1 - DESCRIPTION	1-1	
1. General Description and Capabilities	1-1-1	1
A. General	1-1-1	1
B. Functional Capabilities	1-1-1	1
C. Mechanical Description	1-1-1	2
SECTION 2 - OPERATION	1-2	
1. Installation	1-2-1	1
A. Controls, Connectors and Indicators	1-2-1	1
B. Safety Precautions	1-2-1	1
(1) Complying with Instructions	1-2-1	1
(2) Grounding Equipment and Power Cord	1-2-1	1
(3) Operating Safety	1-2-1	1
(4) CAUTION and WARNING Labels	1-2-1	1
C. Power Requirements	1-2-1	2
D. Power-Up Procedure	1-2-1	2
E. Rack-Mount Installation	1-2-1	2
2. Description of Controls, Connectors and Indicators	1-2-2	2
3. Performance Evaluation	1-2-3	1
A. General	1-2-3	1
B. Pre-Operational Conditions	1-2-3	1
C. Controls, Connectors and Indicators	1-2-3	1
D. Test Equipment Requirements	1-2-3	1
E. Corrective Maintenance Procedures	1-2-3	1
F. Test Record	1-2-3	2
G. Performance Evaluation Procedures	1-2-3	2
(1) RF	1-2-3	2
(2) IF	1-2-3	3
(3) PRF	1-2-3	4
(4) Range	1-2-3	5
(5) Meter and Tracking Functions	1-2-3	8
(6) R1,R2 AUTO	1-2-3	11
(7) Marker	1-2-3	13
H. Performance Evaluation Data Sheet	1-2-3	14

Title	Chapter/Section/Subject	Page
4. General Operating Procedures	1-2-4	1
A. General	1-2-4	1
B. Pre-Operational Considerations	1-2-4	1
C. Controls, Connectors and Indicators	1-2-4	1
D. Test Equipment Requirements	1-2-4	1
E. Operating Precautions	1-2-4	1
F. Test Setup	1-2-4	2
G. Test Function Procedures	1-2-4	4
(1) Peak Power and Frequency	1-2-4	4
(2) Range Precision	1-2-4	5
(3) Sensitivity	1-2-4	6
(4) Turbulence Detection	1-2-4	7
(5) Dual Target Simulation	1-2-4	8
(6) Effective Power and Automatic Frequency Control (AFC) Centering	1-2-4	10
(7) Minimum Detection Range (MDR)	1-2-4	11
(8) Sensitivity Time Control (STC)	1-2-4	12
(9) Magnetron Pulse Frequency and Phase Deviation	1-2-4	13
(10) IF Testing	1-2-4	18
H. UUT Power Percentage	1-2-4	20
SECTION 3 - SPECIFICATIONS	1-3	
1. RD-301A Radar Test Set Specifications	1-3-1	1
A. RF Signal Generator	1-3-1	1
B. IF Signal Generator	1-3-1	2
C. Modulation	1-3-1	2
D. Range	1-3-1	3
E. Frequency Counter	1-3-1	3
F. Power Meter	1-3-1	4
G. Outputs	1-3-1	4
H. Inputs	1-3-1	5
I. Power	1-3-1	5
SECTION 4 - SHIPPING	1-4	
1. General	1-4-1	1
A. Shipping Information	1-4-1	1
(1) Authorization	1-4-1	1
(2) Tagging Test Sets	1-4-1	1
(3) Shipping Containers	1-4-1	1
(4) Freight Costs	1-4-1	1
B. Repacking Procedure	1-4-1	1
SECTION 5 - STORAGE	1-5	
1. General	1-5-1	1

LIST OF ILLUSTRATIONS

Title	Chapter/Section/Subject	Page
RD-301A Composite	1-1-1	3
RD-301A Front and Rear Panels	1-2-2	2
Reply Pulse Width	1-2-3	6
Effective Power Evaluation Setup Diagram	1-2-3	8
Heterodyne Monitor L-Band Test Signal	1-2-3	9
R1,R2 AUTO Threshold Evaluation Setup Diagram	1-2-3	11
R1,R2 AUTO Threshold Measurement	1-2-3	12
RD-301A/UUT Interface	1-2-4	3
Discriminator Pulse	1-2-4	13
Heterodyne Monitor Output (Aligned Radar)	1-2-4	[illegible]
Heterodyne Monitor Output (Frequency Deviation)	1-2-4	[illegible]
Heterodyne Monitor Output (Mode Split)	1-2-4	[illegible]
Repacking Procedure	1-4-1	2

THIS PAGE INTENTIONALLY LEFT BLANK.

LIST OF TABLES

Title	Chapter/Section/Subject	Page
Recommended Fuse Ratings	1-2-1	2
FREQUENCY Hz/MHz Digital Display Control	1-2-2	3
Range Reply Rings Evaluation	1-2-3	5

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 1 - DESCRIPTION

1. General Description and Capabilities

A. General

The RD-301A Radar Test Set is a precision simulator designed for testing aircraft weather radar and narrow pulse marine radar systems. The solid-state, fully integrated Test Set provides the means of completely testing routine radar functions. The RD-301A also satisfies simulation requirements for new generation non-coherent radar systems. All RF tests and measurements are accomplished by connecting the RD-301A to the Unit Under Test (UUT) with the use of the supplied Serialized Coaxial Cable, Waveguide Coupler and Waveguide Termination (Dummy Load). An optional 10 dB Attenuator is included (when ordered) for radars with output power levels between 12 and 120 kW.

B. Functional Capabilities

The RD-301A incorporates the following features and capabilities:

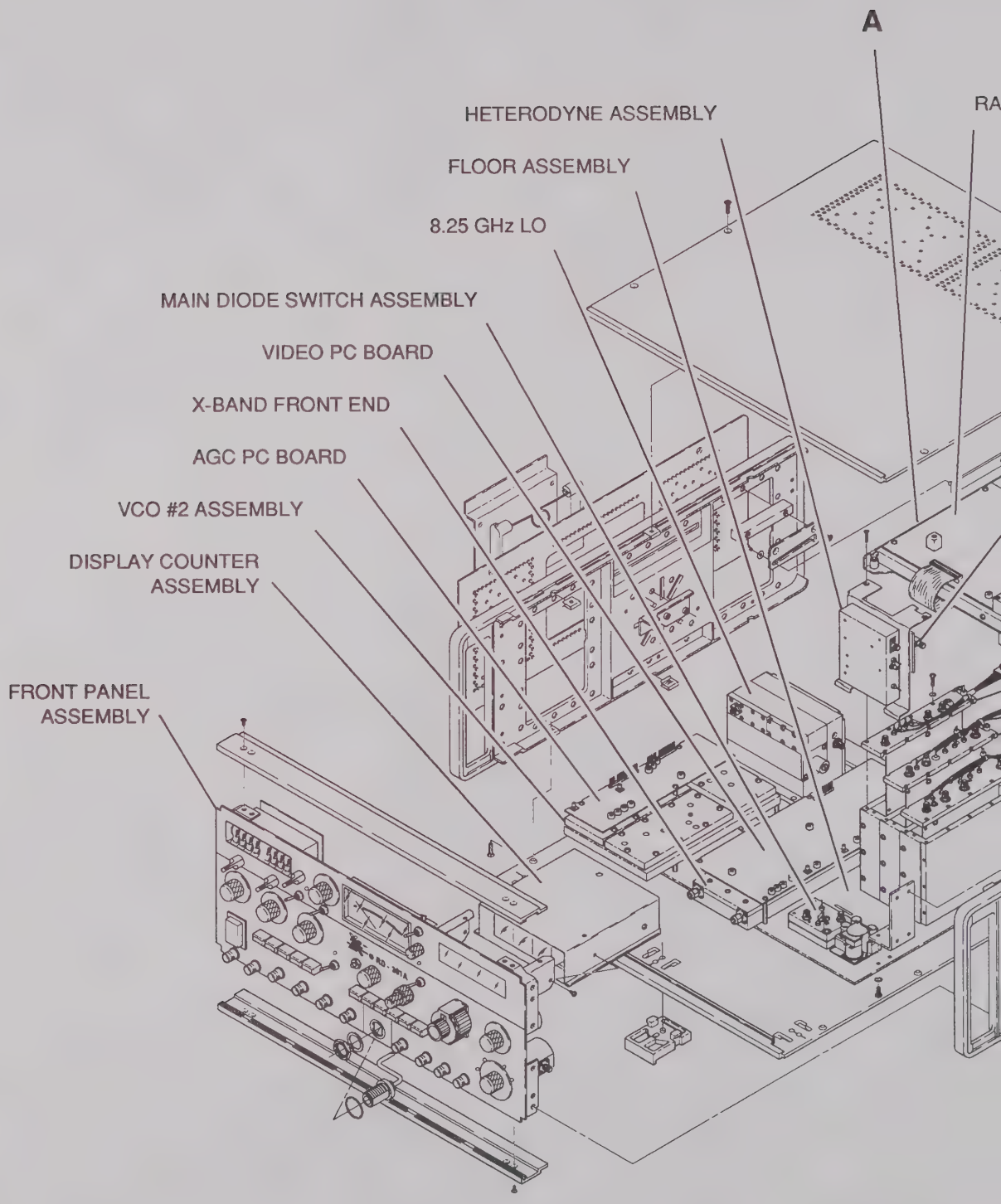
- Automatically acquires, tracks and provides a digital readout of the radar transmitter frequency.
- Provides internal amplitude modulation or accepts external amplitude modulation for simulating target scintillation for turbulence detection radars.
- Responds to radar transmitter pulse widths of 50 ns to 30 µs over a frequency from 9295 to 9500 MHz.
- Measures radar transmitter peak pulse power.
- Displays Effective (EFF) Peak Power, quantitatively showing the effects of phase modulation and frequency pulling in the magnetron.
- Provides for accurate Automatic Frequency Control (AFC) centering alignment on the radar receiver (replacing the requirement for an "echo box").
- Tests radar UUT sensitivity to determine Minimum Discernable Signal (MDS).
- Provides an additional 0 to 20 dB amplitude boost above selected output level for checking radar contour threshold circuits, receiver color and intensity reponse.
- Provides IF sweep generator from 20 to 70 MHz and marker generator for IF and AFC testing.

The RD-301A provides various forms of the UUT transmitter signal for comprehensive radar maintenance and testing. Signals are at the following connectors:

- ANLYZER RF X-BAND XMTR Connector for viewing the radar signal on a spectrum analyzer.
- XMTR DET Connector for viewing radar transmitter pulse shape on oscilloscope.
- XMTR DSCRM .1V/MHz Connector for viewing radar pulse spectral characteristics on an oscilloscope. Pulse frequency changes are shown as amplitude shifts on the oscilloscope.
- XMTR HET MON Connector for oscillosope display of frequency and duration of modes, identifying location and magnitude of phase pulling within the magnetron pulse.

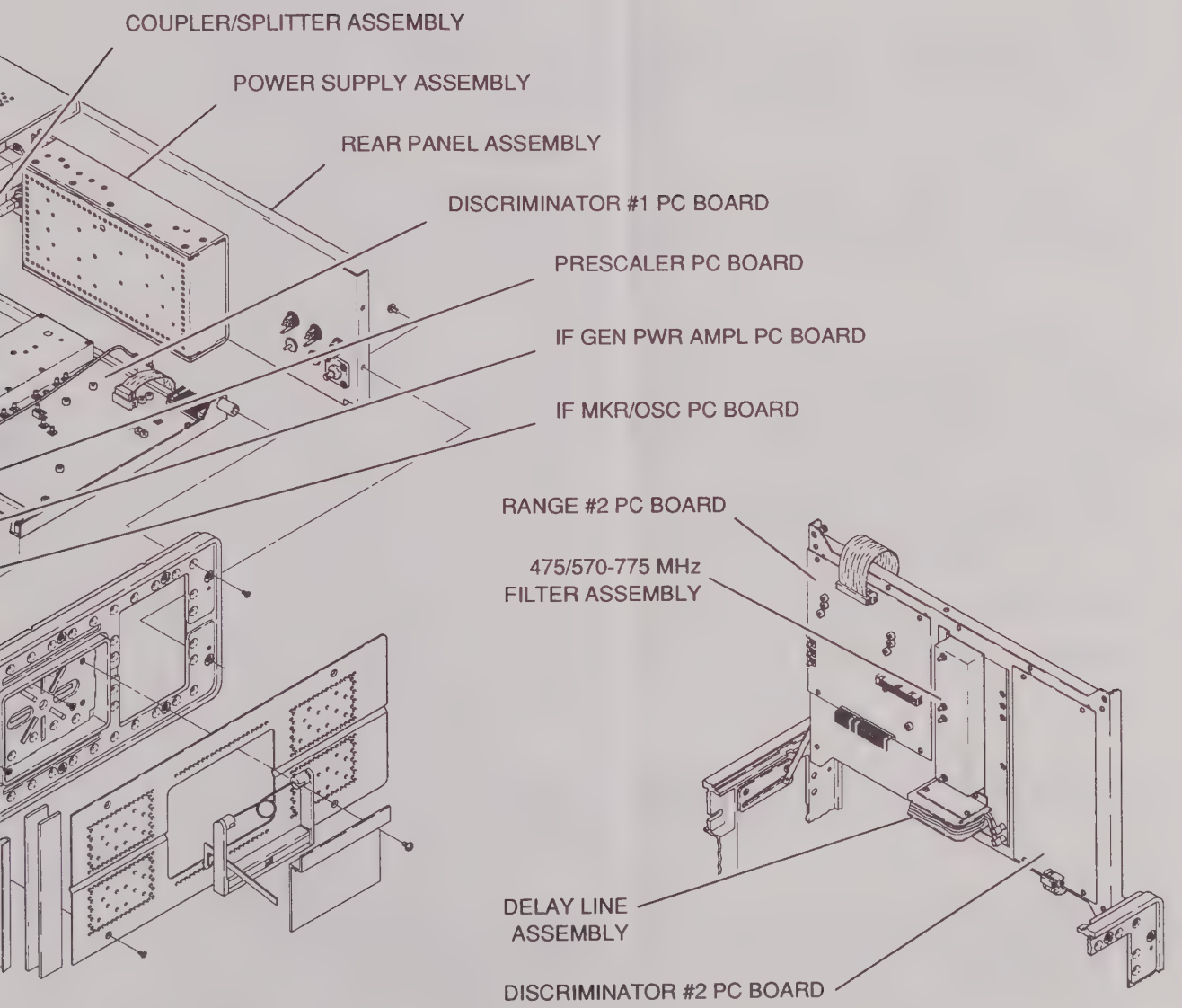
C. Mechanical Description

The RD-301A mechanical description is shown in 1-1-1, Figure 1.


A
HETERODYNE ASSEMBLY
FLOOR ASSEMBLY
8.25 GHz LO
MAIN DIODE SWITCH ASSEMBLY
VIDEO PC BOARD
X-BAND FRONT END
AGC PC BOARD
VCO #2 ASSEMBLY
DISPLAY COUNTER ASSEMBLY
FRONT PANEL ASSEMBLY

BOARD

RD FRAME ASSEMBLY



DETAIL **A**

9007006

RD-301A Composite
Figure 1

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 2 - OPERATION

1. Installation

A. Controls, Connectors and Indicators

RD-301A controls, connectors and indicators are specified with item numbers. The location according to item number of each control, connector and indicator is shown in 1-2-2, Figure 1.

B. Safety Precautions

Listed are several important safety precautions which must be observed during installation and operation. IFR Systems, Inc. assumes no liability for failure to comply with any safety precaution outlined in this manual.

(1) Complying with Instructions

Operating personnel should not attempt to install or operate the RD-301A without reading and complying with all instructions contained in this manual. All procedures must be performed in exact sequence and manner described.

(2) Grounding Equipment and Power Cord

WARNING: ALL EQUIPMENT CHASSIS CABINETS MUST BE CONNECTED TO AN ELECTRICAL GROUND TO MINIMIZE SHOCK HAZARD.

WARNING: DUE TO POTENTIAL SAFETY HAZARDS, USE OF THREE-PRONG TO TWO-PRONG ADAPTOR PLUG IS NOT RECOMMENDED.

The ac power cable included with the Test Set is equipped with a standard three-prong power cable which must be connected to a properly grounded three-prong receptacle. It is the customer's responsibility to:

- Have a qualified electrician check receptacle(s) for proper grounding.
- Replace any standard two-prong receptacle(s) with properly grounded three-prong receptacle(s).

(3) Operating Safety

Due to presence of potentially lethal voltages within the RD-301A, operating personnel must not remove top or bottom covers at any time.

(4) CAUTION and WARNING Labels

Extreme care should be exercised when performing operations preceded by a CAUTION or WARNING Label. CAUTION labels appear where possibility of damage to equipment exists. WARNING labels denote conditions where bodily injury or death may result.

C. Power Requirements

The RD-301A Radar Test Set requires continuous ac power to operate. The internal power supply operates over a voltage range of 103 to 253 VAC. No internal wiring or switching changes are required prior to applying ac power to the RD-301A. Instantaneous surge current on power-up is <50 A. Input current varies to maintain constant power over the input voltage range (≤150 W).

For proper circuit protection, the RD-301A requires a FUSE (51) with correct fuse rating. Recommended fuse ratings according to input voltage are listed in 1-2-1, Table 1.

INPUT VOLTAGE	FUSE RATING	IFR PART NO
103 to 132 VAC	2.0 A, 250 V Fast Blo	5106-0000-017
132 to 253 VAC	1.0 A, 250 V Fast Blo	5106-4501-000

Recommended Fuse Ratings
Table 1

D. Power-Up Procedure

CAUTION: AVOID RESTRICTION OF AIR FLOW THROUGH VENT HOLES IN SIDE PANELS AND ACROSS POWER SUPPLY HEAT SINK ON REAR PANEL WHEN INSTALLING RD-301A.

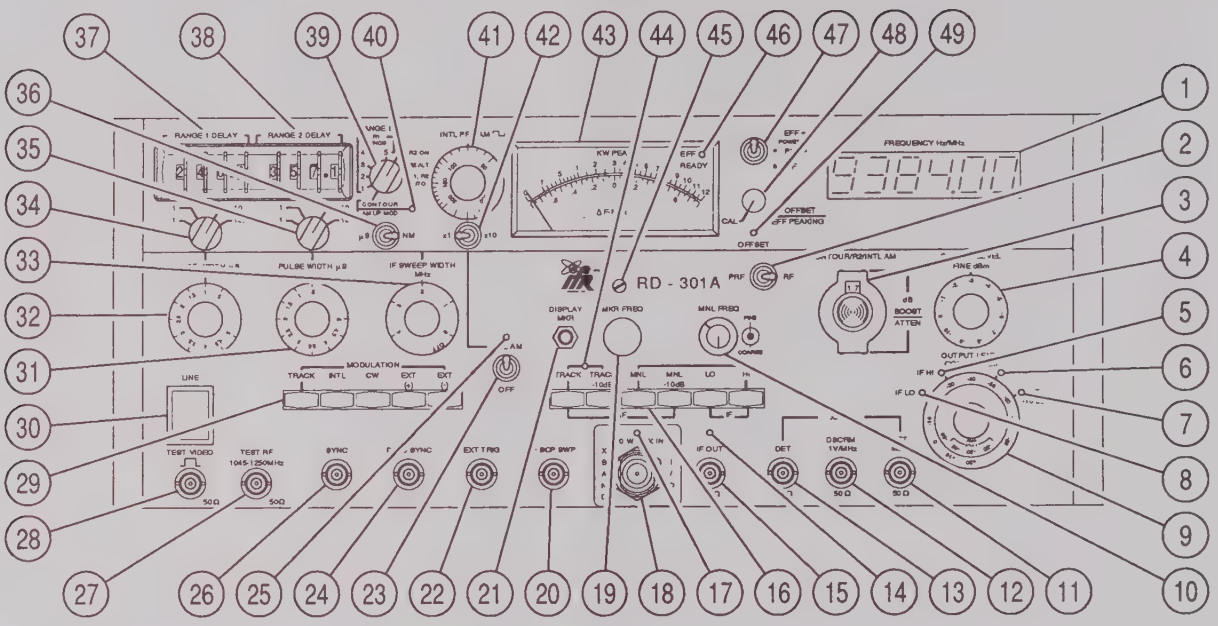
STEP PROCEDURE

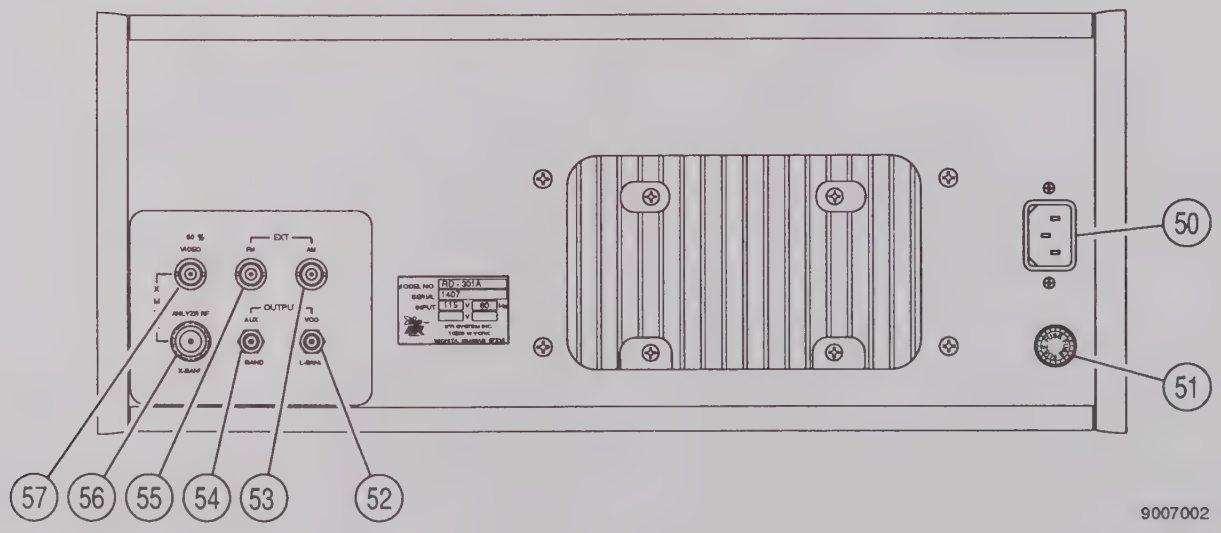
1. Set RD-301A into operating position.
2. Connect ac power cable from AC INPUT Connector (50) to power source.
3. Press LINE Switch (30) ***ON*** and verify LINE Switch (30) illuminates.

E. Rack-Mount Installation

The RD-301A is installed in bench-top or rack-mount fashion. All IFR Systems, Inc. test sets are shipped from the factory with plastic feet installed for bench-top installation. Conversion from bench-top to rack-mount installation requires a Rack-Mount Kit (7001-7636-800). One kit per unit is required for installation. Kits are ordered from the factory.

2. Description of Controls, Connectors and Indicators





1. FREQUENCY Hz/MHz Digital Display
2. PRF/RF Switch
3. CONTOUR/R2/INTL AM dB BOOST/ATTEN Control
4. OUTPUT LEVEL FINE dBm Control
5. IF HI Indicator
6. RF Indicator
7. RF -10 dB Indicator
8. IF LO Indicator
9. OUTPUT LEVEL COARSE dBm Control
10. MNL FREQ Controls
11. XMTR HET MON Connector (J49028)
12. XMTR DSCRM .1V/MHz Connector (J49027)
13. XMTR DET Connector (J49026)
14. IF OUT Indicator
15. IF OUT Connector (J49025)
16. RF/IF MODE Pushbutton Switches
17. X-BAND SIGNAL Indicator
18. X-BAND I/O Connector (J49016)
19. MKR FREQ Control
20. IF SCP SWP Connector (J49012)
21. DISPLAY MKR Switch
22. EXT TRIG Connector (J49024)
23. INTL AM Switch
24. DLYD SYNC Connector (J49023)
25. INTL AM Indicator
26. SYNC Connector (J49022)
27. TEST RF 1045-1250 MHz Connector (J49021)
28. TEST VIDEO Connector (J49020)
29. MODULATION MODE Pushbutton Switches
30. LINE Switch
31. PULSE WIDTH µS Control (RANGE 2)
32. PULSE WIDTH µS Control (RANGE 1)
33. SWEEP WIDTH MHz Control
34. PULSE WIDTH MULTIPLIER Control (RANGE 1)
35. PULSE WIDTH MULTIPLIER Control (RANGE 2)
36. µS/NM Switch
37. RANGE 1 DELAY Thumbwheels
38. RANGE 2 DELAY Thumbwheels
39. RANGE SEL Switch
40. CONTOUR/AM UP MOD Indicator
41. INTL PRF/AM Control
42. X1/X10 INTL PRF/AM Switch
43. PANEL Meter
44. TRACK Indicator
45. PANEL METER ZERO Control
46. EFF READY Indicator
47. METER SELECT Switch
48. ΔF OFFSET/EFF PEAKING Control
49. OFFSET Indicator
50. AC INPUT Connector (J49008)
51. FUSE
52. VCO L-BAND OUTPUT Connector (J49004)
53. AM EXT INPUT Connector (J49005)
54. AUX X-BAND OUTPUT Connector (J49002)
55. FM EXT INPUT Connector (J49006)
56. ANLYZER RF X-BAND XMTR Connector (J49003)
57. 50% VIDEO XMTR Connector (J49007)

RD-301A Front and Rear Panels
Figure 1

THIS PAGE INTENTIONALLY LEFT BLANK.

ITEM DESCRIPTION

1. FREQUENCY Hz/MHz Digital Display

   Displays PRF (Hz), IF (MHz) or RF (MHz) as selected with PRF/RF Switch (2) and RF/IF MODE Pushbutton Switches (16). Marker frequency (Hz) is displayed when DISPLAY MKR Switch (21) is pressed. Refer to 1-2-2, Table 2.

FREQUENCY TYPE	MODE	DISPLAY
PRF	RF TRACK/RF TRACK -10 dB	UUT Transmitter PRF
PRF	INTL	RD-301A Internal Oscillator PRF (Internal AM frequency, if On)
PRF	EXT (+), EXT (-)	External Trigger Signal PRF
RF	IF LO/IF HI	IF Signal Generator Frequency
RF	IF LO/IF HI, DISPLAY MKR Switch (21) pressed	IF Marker Frequency
RF	RF TRACK/RF TRACK -10 dB	RF Signal Generator/UUT Transmitter Frequency
RF	RF MNL/RF MNL -10 dB	RF Signal Generator Frequency

FREQUENCY Hz/MHz Digital Display Control
Table 2

2. PRF/RF Switch

   Toggle switch selects type of frequency shown on FREQUENCY Hz/MHz Digital Display (1). Refer to 1-2-2, Table 2.

3. CONTOUR/R2/INTL AM dB BOOST/ATTEN Control

   Boosts or attenuates output level set with OUTPUT LEVEL COARSE dBm Control (9) and OUTPUT LEVEL FINE dBm Control (4). Inner knob controls level in 1 dB steps (0-9). Outer knob controls level in 10 dB steps (0-50). Selection appears in small viewing window at top center of control.

   Boost is activated when RANGE SEL Switch (39) is in CONTOUR/AM MOD UP position and applies to output levels from -127 to -75 dBm. CONTOUR/R2/INTL AM dB BOOST/ATTEN Control boosts contour or internal AM level from 0 to 20 dB above selected output level.

   NOTE: Selecting >20 dB boost produces minimal or no additional level increase >20 dB.

   Attenuation is activated when RANGE SEL Switch (39) is in any R2 position (R2 ON; R2 ALT or R1,R2 AUTO) or RINGS 1 through 5 with internal AM activated. Range 2 reply or internal AM is attenuated from 0 to -59 dB referenced to Range 1 reply level set with OUTPUT LEVEL COARSE dBm Control (9) and OUTPUT LEVEL FINE dBm Control (4).

ITEM DESCRIPTION

4. OUTPUT LEVEL FINE dBm Control

   Decreases RF or IF output level in 1 dB steps referenced to level set with OUTPUT LEVEL COARSE dBm Control (9). Range is from 0 to -10 dB.

5. IF HI Indicator

   Green LED illuminates when IF HI is selected with RF/IF MODE Pushbutton Switches (16). Green indicates color of scale used on OUTPUT LEVEL COARSE dBm Control (9).

6. RF Indicator

   Red LED illuminates when RF TRACK or RF MNL is selected with RF/IF MODE Pushbutton Switches (16). Red indicates color of scale used on OUTPUT LEVEL COARSE dBm Control (9).

7. RF -10 dB Indicator

   Red LED illuminates when RF TRACK -10 dB or RF MNL -10 dB is selected with RF/IF MODE Pushbutton Switches (16). Red indicates color of scale used on OUTPUT LEVEL COARSE dBm Control (9).

8. IF LO Indicator

   Red LED illuminates when IF LO is selected with RF/IF MODE Pushbutton Switches (16). Red indicates color of scale used on OUTPUT LEVEL COARSE dBm Control (9).

9. OUTPUT LEVEL COARSE dBm Control

   Varies RF or IF output level in 10 dB increments. Red and green scales on control knob are used according to mode selected with RF/IF MODE Pushbutton Switches (16). Each mode is indicated with an index mark and red or green LED. RF output level is calibrated to -127 dBm using the red scale.

10. MNL FREQ Controls

    Sets signal generator frequency for RF MNL, RF MNL -10 dB, IF LO or IF HI mode selected with RF/IF MODE Pushbutton Switches (16). Coarse adjust (outer knob) and fine adjust (inner knob) set frequency shown on FREQUENCY Hz/MHz Digital Display (1).

11. XMTR HET MON Connector (J49028)

    Provides output for displaying radar transmitter pulse frequency characteristics on external oscilloscope. BNC connector requires 50 Ω load for operation.

ITEM DESCRIPTION

12. XMTR DSCRM .1V/MHz Connector (J49027)

    Provides output for displaying radar transmitter frequency versus time characteristics on external oscilloscope. BNC connector requires 50 Ω load for an output calibrated at 0.1 V/MHz. System reference pulse, 5 µs wide, occurs approximately 15 µs after transmitter pulse. Reference voltage corresponds to frequency shown on FREQUENCY Hz/MHz Digital Display (1).

13. XMTR DET Connector (J49026)

    Provides output for displaying radar transmitter pulse shape characteristics on external oscilloscope. BNC connector requires 50 Ω load to preserve pulse fidelity.

14. IF OUT Indicator

    Red LED illuminates when IF LO or IF HI is selected with RF/IF MODE Pushbutton Switches (16) and indicates IF output is available at IF OUT Connector (15).

15. IF OUT Connector (J49025)

    Provides IF signal generator output. Signal level is set with OUTPUT LEVEL FINE dBm Control (4) and OUTPUT LEVEL COARSE dBm Control (9). BNC connector requires 50 Ω load for operation.

16. RF/IF MODE Pushbutton Switches

    Selects one of the following RF or IF operating modes:

    - RF TRACK

      RF signal generator acquires and tracks frequency of UUT transmitter signal received through X-BAND I/O Connector (18). RF Indicator (6) and X-BAND SIGNAL Indicator (17) illuminate when RF TRACK mode is selected.

    - RF TRACK -10 dB

      Used with external 10 dB coaxial attenuator inserted at Waveguide Coupler to provide for UUT transmitters with >12 kW (up to 120 kW) peak power output. RF signal generator acquires and tracks frequency of UUT transmitter signal received through X-BAND I/O Connector (18). RF -10 dB Indicator (7) and X-BAND SIGNAL Indicator (17) illuminate when RF TRACK -10 dB mode is selected.

      NOTE: Transmitting replies from the RD-301A while the UUT transmitter is operating during TRACK operations may cause tracking inaccuracies at high generator levels (>-75 dBm). To avoid possible tracking error, the range delay is set greater than the UUT transmitter pulse width.

ITEM DESCRIPTION

- RF MNL

  RF signal generator frequency is set from 9.295 to 9.500 GHz with MNL FREQ Controls (10). Output is calibrated at R/T unit with Serialized Coaxial Cable and Waveguide Coupler. RF Indicator (6) and X-BAND SIGNAL Indicator (17) illuminate when RF MNL mode is selected.

- RF MNL -10 dB

  Used with external 10 dB Attenuator inserted at Waveguide Coupler to provide for UUT transmitters with >12 kW (up to 120 kW) peak power output. RF signal generator frequency is set from 9.295 to 9.500 GHz with MNL FREQ Controls (10). X-BAND SIGNAL Indicator (17) and RF -10 dB Indicator (7) illuminate when RF MNL -10 dB mode is selected.

- IF LO

  Activates IF signal generator in low power range from -132 to -20 dBm as selected with OUTPUT LEVEL FINE dBm Control (4) and OUTPUT LEVEL COARSE dBm Control (9). MNL FREQ Controls (10) vary IF frequency from 20 to 70 MHz. IF LO Indicator (8) and IF OUT Indicator (14) illuminate when IF LO mode is selected.

- IF HI

  Activates IF signal generator in high power range from -92 to +20 dBm as selected with OUTPUT LEVEL FINE dBm Control (4) and OUTPUT LEVEL COARSE dBm Control (9). MNL FREQ Controls (10) vary IF frequency from 20 to 70 MHz. IF HI Indicator (5) and IF OUT Indicator (14) illuminate when IF HI mode is selected.

17. X-BAND SIGNAL Indicator

    Red LED illuminates when RF TRACK, RF TRACK -10 dB, RF MNL or RF MNL -10 dB is selected with RF/IF MODE Pushbutton Switches (16) and indicates RF output is available at the X-BAND I/O Connector (18).

18. X-BAND I/O Connector (J49016)

    N connector couples RD-301A to UUT through antenna waveguide. Output is calibrated at R/T unit using Serialized Coaxial Cable and Waveguide Coupler furnished with Test Set. Output level is set using the OUTPUT LEVEL COARSE dBm Control (9), OUTPUT LEVEL FINE dBm Control (4) and (if applicable) CONTOUR/R2/INTL AM dB BOOST/ATTEN Control (3).

    CAUTION: MAXIMUM INPUT LEVEL CANNOT EXCEED 120 W.

19. MKR FREQ Control

    Adjusts IF marker frequency when DISPLAY MKR Switch (21) is pressed.

ITEM DESCRIPTION

20. IF SCP SWP Connector (J49012)

    BNC connector provides an approximate 5 V_{P-P}, 100 Hz ramp output for horizontal drive to external oscilloscope during IF sweep tests.

21. DISPLAY MKR Switch

    Momentary contact switch adds marker signal (approximately -20 dBc) to IF output, when pressed. Marker frequency is set with MKR FREQ Control (19) and shown on FREQUENCY Hz/MHz Digital Display (1).

22. EXT TRIG Connector (J49024)

    BNC connector used to apply external trigger when EXT (+) or EXT (-) is selected with MODULATION MODE Pushbutton Switches (29). Trigger input requires 2 to 25 V peak pulse or sine wave to initiate range delay.

23. INTL AM Switch

    INTL AM (On)/OFF toggle switch adds 50% AM (square wave) to reply pulse output. Frequency is set with INTL PRF/AM Control (41) and X1/X10 INTL PRF/AM Switch (42). Amplitude is set with CONTOUR/R2/INTL AM BOOST/ATTEN Control (3) and is relative to output level set with OUTPUT LEVEL FINE dBm Control (4) and OUTPUT LEVEL COARSE dBm Control (9).

24. DLYD SYNC Connector (J49023)

    BNC connector provides delayed synchronous pulse output to external oscilloscope. Leading edge of positive pulse is coincident with leading edge of reply pulse.

25. INTL AM Indicator

    Red LED illuminates when internal AM is activated with INTL AM Switch (23).

26. SYNC Connector (J49022)

    BNC connector provides synchronous pulse output to external oscilloscope. Leading edge of positive pulse is coincident with start of each range delay.

27. TEST RF 1045-1250 MHz Connector (J49021)

    BNC connector, providing 50 Ω load, receives L-Band test signals for calibration and verification of tracking circuits.

28. TEST VIDEO Connector (J49020)

    BNC connector, providing 50 Ω load, receives external pulse signals and is used with TEST RF 1045-1250 MHz Connector (27) for calibration and verification.

ITEM DESCRIPTION

29. MODULATION MODE Pushbutton Switches

Selects range delay trigger source or enables continuous wave output. Selectable modes are as follows:

- TRACK

  Starts range delay coincident with leading edge of UUT transmitter pulse at 50% amplitude point.

- INTL

  Starts range delay with every leading edge of pulses generated by internal PRF oscillator. Triggering rate is set with INTL PRF/AM Control (41).

- CW

  Selects continuous wave RF output at X-BAND I/O Connector (18) or continuous wave IF output at IF OUT Connector (15) according to RF/IF MODE Pushbutton Switches (16).

- EXT (+)

  Starts range delay when triggered with rising edge of a 2 to 25 V peak pulse or positive half of sine wave input applied to EXT TRIG Connector (22).

- EXT (-)

  Starts range delay when triggered with falling edge of a 2 to 25 V peak pulse or negative half of sine wave input applied to EXT TRIG Connector (22).

30. LINE Switch

Applies power to RD-301A. Illuminates when power is ON.

31. PULSE WIDTH µS Control (RANGE 2)

Adjusts Range 2 reply pulse width from 0.05 to 500 µs, depending on PULSE WIDTH MULTIPLIER Control (RANGE 2) (35) setting. PULSE WIDTH µS Control (RANGE 2) setting is variable from 0.5 to 5 µs and is multiplied by the PULSE WIDTH MULTIPLIER Control (RANGE 2) (35) setting to obtain the Range 2 reply pulse width.

32. PULSE WIDTH µS Control (RANGE 1)

Adjusts pulse width from 0.05 to 500 µs, depending on PULSE WIDTH MULTIPLIER Control (RANGE 1) (34) setting. PULSE WIDTH µS Control (RANGE 1) setting is variable from 0.5 to 5 µs and is multiplied by the PULSE WIDTH MULTIPLIER Control (RANGE 1) (34) setting to obtain the pulse width. Range 1 reply width is set in RF operating modes or IF pulse width is set in IF operating modes according to RF/IF MODE Pushbutton Switches (16).

ITEM DESCRIPTION

33. SWEEP WIDTH MHz Control

Sets sweep width (in MHz) of IF signal generator output. Sweep width is set from 0 to 4 MHz. Sweep rate is 100 Hz. Control has detent OFF position.

34. PULSE WIDTH MULTIPLIER Control (RANGE 1)

Selects multiplier (.1, 1, 10 or 100) used with PULSE WIDTH µS Control (RANGE 1) (32) setting. The PULSE WIDTH MULTIPLIER Control (RANGE 1) setting multiplied by the PULSE WIDTH µS Control (RANGE 1) (32) setting obtains Range 1 reply or IF pulse width.

35. PULSE WIDTH MULTIPLIER Control (RANGE 2)

Selects multiplier (.1, 1, 10 or 100) used with PULSE W!DTH µS Control (RANGE 2) (31) setting. The PULSE WIDTH MULTIPLIER Control (RANGE 2) setting multiplied by the PULSE WIDTH µS Control (RANGE 2) (31) setting obtains Range 2 reply pulse width.

36. µS/NM Switch

Selects unit of measurement (microseconds [µS] or nautical miles [NM]) for both Range 1 and Range 2 simulated reply delays.

37. RANGE 1 DELAY Thumbwheels

Sets delay for Range 1 simulated reply. Delay is set from 0.1 to 999.9 in microseconds or nautical miles depending on position of µS/NM Switch (36). A residual time delay (nominally 0.1 µs) is added to the delay set by RANGE 1 DELAY Thumbwheels. The source selected by the MODULATION MODE Pushbutton Switches (29) triggers the delay.

38. RANGE 2 DELAY Thumbwheels

Sets delay for Range 2 simulated reply. Delay is set from 0.2 to 999.9 in microseconds or nautical miles depending on position of µS/NM Switch (36). A residual time delay (nominally 0.4 µs) is added to the delay set by RANGE 2 DELAY Thumbwheels. The source selected by the MODULATION MODE Pushbutton Switches (29) triggers the delay.

ITEM DESCRIPTION

39. RANGE SEL Switch

Provides simulated reply variations. Nine position rotary switch selects boost, selects number of Range 1 reply rings (1-5) or activates Range 2 reply.

- CONTOUR/AM UP MOD

  Provides selectable 0 to 20 dB boost above level set with OUTPUT LEVEL FINE dBm Control (4) and OUTPUT LEVEL COARSE dBm Control (9). Boost is set using CONTOUR/R2/INTL AM dB BOOST/ATTEN Control (3) and only applies when initial output levels are from -75 to -127 dBm. Range 1 reply is boosted when INTL AM Switch (23) is OFF. Internal AM is boosted when INTL AM Switch (23) is set to INTL AM.

- RINGS 1 through 5

  Selects number of equally spaced simulated Range 1 replies transmitted by the RD-301A. RANGE 1 DELAY Thumbwheels (37) set Ring 1 delay and distance between all succeeding rings (equidistant). Minimum range for Rings 2 through 5 is 0.3 µs or 0.3 nmi.

- R2 ON

  Activates Range 2 reply in addition to Range 1 reply. Range 1 output level is set with OUTPUT LEVEL FINE dBm Control (4) and OUTPUT LEVEL COARSE dBm Control (9). Range 2 output level is attenuated from Range 1 output level with CONTOUR/R2/INTL AM dB BOOST/ATTEN Control (3). Range 2 delay is set with RANGE 2 DELAY Thumbwheels (38).

- R2 ALT

  Activates Range 1 reply with every trigger as selected with MODULATION MODE Pushbutton Switches (29) and Range 2 reply every other trigger. Range 2 output level is attenuated from Range 1 output level with CONTOUR/R2/INTL AM dB BOOST/ATTEN Control (3).

- R1/R2 AUTO

  Automatically selects Range 1 or Range 2 reply depending on width of UUT transmitter pulse. Only Range 1 reply responds when UUT transmitter pulse width is <0.4 µs. Only Range 2 reply responds when UUT transmitter pulse width is >0.4 µs.

  NOTE: If Range 1 delay set by RANGE 1 DELAY Thumbwheels (37) is <0.4 µs, Range 1 reply always responds. If Range 2 delay set by RANGE 2 DELAY Thumbwheels (38) is <0.4 µs, Range 2 reply never responds.

  NOTE: The factory calibrated threshold setting is 0.4 µs. The threshold setting is adjustable from 0.2 to 1.0 µs. Refer to the RD-301A Maintenance Manual for adjustment procedures.

ITEM DESCRIPTION

40. CONTOUR/AM UP MOD Indicator

Red LED illuminates when CONTOUR/AM UP position is selected with RANGE SEL Switch (39).

41. INTL PRF/AM Control

Used with X1/X10 INTL PRF/AM Switch (42) to regulate the RD-301A internal oscillator frequency (Internal PRF and/or AM frequency). INTL PRF/AM Control sets internal AM frequency when INTL AM Switch (23) is set to INTL AM. INTL PRF/AM Control sets internal PRF when INTL is selected with MODULATION MODE Pushbutton Switches (29). INTL PRF/AM Control sets both internal PRF and AM frequency when INTL AM Switch (23) is set to INTL AM and INTL is selected with MODULATION MODE Pushbutton Switches (29). Frequency is adjustable from 50 to 500 Hz or 500 to 5000 Hz, depending on X1/X10 INTL PRF/AM Switch (42) position.

42. X1/X10 INTL PRF/AM Switch

Selects multiplier (X1 or X10) used with INTL PRF/AM Control (41) setting. The INTL PRF/AM Control (41) setting multiplied by 1 or 10 as selected with the X1/X10 INTL PRF/AM Switch provides the RD-301A internal oscillator frequency.

43. PANEL Meter

Indicates effective peak power of UUT transmitter, peak power of UUT transmitter or frequency offset between UUT transmitter and RD-301A Test Set signal generator. PANEL Meter operates when RF TRACK or RF TRACK -10 dB is selected with RF/IF MODE Pushbutton Switches (16). Function is selected by METER SELECT Switch (47).

- KW PEAK Scale

  Indicates effective peak or peak RF power of UUT transmitter at X-BAND I/O Connector (18) using a 0.1 to 12 kW range. KW PEAK Scale is used when METER SELECT Switch (47) is set to EFF POWER or PK POWER positions. For units above 12 kW (up to 120 kW), an external 10 dB Attenuator is connected to the Waveguide Coupler output (UUT power is scale reading multiplied by ten). Power is calibrated and accuracy specified from 1.0 to 12 kW.

  NOTE: Correct calibration depends on the use of the Waveguide Coupler and Serialized Coaxial Cable furnished with RD-301A Test Set. If a replacement coupler or cable is used, the Test Set must be recalibrated.

- ΔF-MHz Scale

  Displays amount of offset between UUT transmitter frequency and Test Set signal generator frequency. Offset is adjusted with ΔF OFFSET/EFF PEAKING Control (48). The ΔF-MHz Scale is used when METER SELECT Switch (47) is set to ΔF position.

ITEM DESCRIPTION

44. TRACK Indicator

Red LED illuminates when Test Set RF signal generator system has acquired and is tracking UUT transmitter frequency.

45. PANEL METER ZERO Control

Inset screw used to align PANEL Meter (43) needle to zero when LINE Switch (30) is OFF.

46. EFF READY Indicator

Green LED illuminates when Test Set is ready to measure UUT effective peak power.

47. METER SELECT Switch

Toggle switch selects PANEL Meter (43) operating mode as follows:

- EFF (Effective) (Peak) POWER - PANEL Meter (43) displays in kilowatts, the UUT effective peak power resulting from effects of phase distortion and frequency inconsistencies of the UUT transmitter pulse.
- PK (Peak) POWER - PANEL Meter (43) displays UUT peak power in kilowatts.
- ΔF (Frequency Offset) - PANEL Meter (43) displays frequency offset from UUT frequency ≤±75 kHz as adjusted by ΔF OFFSET/EFF PEAKING Control (48).

48. ΔF OFFSET/EFF PEAKING Control

Offsets RD-301A internal RF signal generator frequency from UUT transmitter frequency from 0 to ±0.75 MHz and is used when RF TRACK or RF TRACK -10 dB is selected with RF/IF MODE Pushbutton Switches (16). CAL (detent) position provides zero offset (RF signal generator frequency = UUT transmitter frequency). Offset is displayed using ΔF Scale on PANEL METER (43) when METER SELECT Switch (47) is in ΔF position.

49. OFFSET Indicator

Red LED illuminates when ΔF OFFSET/EFF PEAKING Control (48) is not in CAL (detent) position and RF TRACK or RF TRACK -10 dB is selected with RF/IF MODE Pushbutton Switches (16). LED indicates RD-301A is tracking magnetron frequency with offset determined by ΔF OFFSET/EFF PEAKING Control (48).

50. AC INPUT Connector (49008)

Provides for 115 to 230 VAC single phase power input to the RD-301A. Power Supply Assembly automatically adjusts according to source voltage available.

ITEM DESCRIPTION

51. FUSE

    2.0 A, 250 V Fast Blo for 115 VAC operation or 1.0 A, 250 V Fast Blo for 230 VAC operation.

52. VCO L-BAND OUTPUT Connector (J49004)

    SMA connector provides VCO sample for testing tracking accuracy at L-Band.

53. AM EXT INPUT Connector (J49005)

    BNC connector provides input for external amplitude modulation. Sine, square or triangle wave signal input modulates the RD-301A reply pulse. External modulation source is 0 to 5 V_{P-P} providing up to 50% AM, depending on source frequency. (3 dB bandwidth at 3 V_{P-P} and 30% AM is from 30 Hz to 5 kHz.)

54. AUX X-BAND OUTPUT Connector (J49002)

    SMA connector provides auxiliary RF output from X-Band front end for signal generator applications and calibrating tracking accuracy of Test Set at X-Band. Output level is set with OUTPUT LEVEL FINE dBm Control (4) and OUTPUT LEVEL COARSE dBm Control (9).

55. FM EXT INPUT Connector (J49006)

    BNC connector provides input for external frequency modulation.

56. ANLYZER RF X-BAND XMTR Connector (J49003)

    N connector provides radar signal attenuated by 56 to 68 dB for a spectrum analyzer to check X-Band front end.

57. 50% VIDEO XMTR Connector (J49007)

    BNC connector provides detected pulses from the radar transmitter at TTL level and sliced at the 50% amplitude points.

THIS PAGE INTENTIONALLY LEFT BLANK.

3. Performance Evaluation

A. General

Performance Evaluation consists of a series of quick functional checks of the RD-301A front panel controls, connectors and indicators.

PERFORMANCE EVALUATION PROCEDURE	PAGE
RF	2
IF	3
PRF	4
Range	5
Meter and Tracking Functions	8
R1,R2 AUTO	11
Marker	13

B. Pre-Operational Considerations

For maximum benefit, it is strongly recommended that personnel:

- Read and understand all steps of each procedure, prior to completion.
- Be familiar with the RD-301A as to power, frequency and waveform to be expected at each test point.

C. Controls, Connectors and Indicators

RD-301A controls, connectors and indicators are specified with item numbers. The location according to item number of each control, connector and indicator is shown in 1-2-2, Figure 1.

D. Test Equipment Requirements

Appendix B contains a comprehensive list of test equipment suitable for performing the Performance Evaluation Procedures. Other test equipment meeting the specifications listed in Appendix B may be substituted for the recommended models.

NOTE: Some test equipment listed in Appendix B may exceed the minimum required specifications for certain Performance Evaluation Procedures.

E. Corrective Maintenance Procedures

The Performance Evaluation Procedures aid the technician in determining if the RD-301A is functioning properly or a failure condition exists. A failure condition is reflected as a calibration error (measurement or reading not within prescribed tolerance) or a malfunction (signal is absent or extremely out of tolerance).

If a failure condition is confirmed, refer to 2-2-2 in the RD-301A Maintenance Manual or return the RD-301A to an authorized repair facility.

F. Test Record

A Performance Evaluation Data Sheet is provided for recording the results obtained while performing the Performance Evaluation Procedures.

NOTE: It is recommended that personnel reproduce copies of the Performance Evaluation Data Sheet, rather than use the copy in this manual.

G. Performance Evaluation Procedures

(1) RF

TEST EQUIPMENT: None

STEP	PROCEDURE

1. Apply power to RD-301A and allow for 30 minute stabilization period.
2. Set RD-301A controls as follows:

CONTROL		SETTING
(2)	PRF/RF Switch	***RF***
(10)	MNL FREQ Controls	***fully ccw***
(16)	RF/IF MODE Pushbutton Switches	***RF MNL***
(29)	MODULATION MODE Pushbutton Switches	***INTL***

3. Verify RF Indicator (6) and X-BAND SIGNAL Indicator (17) illuminate.
4. Verify ≤9295 MHz on FREQUENCY Hz/MHz Digital Display (1).
5. Turn MNL FREQ Controls (10) ***fully cw***.
6. Verify ≥9500 MHz on FREQUENCY Hz/MHz Digital Display (1).

(2) IF

TEST EQUIPMENT: 1 Frequency Counter

STEP	PROCEDURE

1. Apply power to RD-301A and allow for 30 minute stabilization period.
2. Set RD-301A controls as follows

CONTROL		SETTING
(4)	OUTPUT LEVEL FINE dBm Control	***0***
(10)	MNL FREQ Controls	***fully cw***
(16)	RF/IF MODE Pushbutton Switches	***IF LO***
(29)	MODULATION MODE Pushbutton Switches	***CW***

3. Connect Frequency Counter to IF OUT Connector (15).
4. Set OUTPUT LEVEL COARSE dBm Control (9) to ***-20*** (red scale, IF LO index mark).
5. Verify IF LO Indicator (8) and IF OUT Indicator (14) illuminate.
6. Verify ≥70 MHz on FREQUENCY Hz/MHz Digital Display (1).
7. Verify FREQUENCY Hz/MHz Digital Display (1) reading equals Frequency Counter reading (±7 kHz).
8. Turn MNL FREQ Controls (10) ***fully ccw***.
9. Verify ≤20 MHz on FREQUENCY Hz/MHz Digital Display (1).
10. Verify FREQUENCY Hz/MHz Digital Display (1) reading equals Frequency Counter reading (±2 kHz).
11. Set RF/IF MODE Pushbutton Switches (16) to ***IF HI***.
12. Verify IF HI Indicator (5) illuminates and IF LO Indicator (8) does not.
13. Disconnect Frequency Counter from IF OUT Connector (15).

(3) PRF

TEST EQUIPMENT: 1 Frequency Counter

STEP PROCEDURE

1. Apply power to RD-301A and allow for 30 minute stabilization period.

2. Set RD-301A controls as follows:

CONTROL		SETTING
(2)	PRF/RF Switch	***PRF***
(23)	INTL AM Switch	***OFF***
(29)	MODULATION MODE Pushbutton Switches	***INTL***
(41)	INTL PRF/AM Control	***50***
(42)	X1/X10 INTL PRF/AM Switch	***X1***

3. Connect Frequency Counter to SYNC Connector (26).

4. Verify ≈50 Hz on FREQUENCY Hz/MHz Digital Display (1).

5. Verify FREQUENCY Hz/MHz Digital Display (1) reading equals Frequency Counter reading (±1 Hz).

6. Turn INTL PRF/AM Control (41) ***fully cw***.

7. Verify FREQUENCY Hz/MHz Digital Display (1) increases to ≥500 Hz.

8. Verify FREQUENCY Hz/MHz Digital Display (1) reading equals Frequency Counter reading (±1 Hz).

9. Set X1/X10 INTL PRF/AM Switch (42) to ***X10***.

10. Verify ≥5000 Hz on FREQUENCY Hz/MHz Digital Display (1).

11. Verify FREQUENCY Hz/MHz Digital Display (1) reading equals Frequency Counter reading (±2 Hz).

12. Turn INTL PRF/AM Control (41) ***fully ccw***.

13. Verify FREQUENCY Hz/MHz Digital Display (1) decreases to ≤500 Hz.

14. Verify FREQUENCY Hz/MHz Digital Display (1) reading equals Frequency Counter reading (±1 Hz).

15. Disconnect Frequency Counter from SYNC Connector (26).

16. Select each mode other than ***INTL*** on MODULATION MODE Pushbutton Switches (29) and verify FREQUENCY Hz/MHz Digital Display (1) reads 0 Hz.

(4) Range

TEST EQUIPMENT: 1 Oscilloscope

STEP PROCEDURE

1. Apply power to RD-301A and allow for 30 minute stabilization period.

2. Set RD-301A as follows:

CONTROL		SETTING
(2)	PRF/RF Switch	***PRF***
(29)	MODULATION MODE Pushbutton Switches	***INTL***
(32)	PULSE WIDTH µS Control (RANGE 1)	***20***
(34)	PULSE WIDTH MULTIPLIER Control (RANGE 1)	***1***
(36)	µS/NM Switch	***µS***
(37)	RANGE 1 DELAY Thumbwheels	***000.0***
(39)	RANGE SEL Switch	***RINGS 1***
(41)	INTL PRF/AM Control	***500***
(42)	X1/X10 INTL PRF/AM Switch	***X1***

3. Connect Oscilloscope Channel 1 to DLYD SYNC Connector (24) and Channel 2 to SYNC Connector (26).

4. Set Oscilloscope to display both channels (dc coupled) as follows:

CONTROL	SETTING
Trigger	Channel 2
Channel 1 Amplitude	0.5 V/Div
Channel 2 Amplitude	2 V/Div
Sweep Speed	0.2 ms/Div

5. Set RANGE 1 DELAY Thumbwheels (37) to ***200.0***. Verify Range 1 reply pulse (Delayed Sync pulse) moves right ≈200 µs (one major division).

6. Set RANGE SEL Switch (39) according to 1-2-3, Table 3 and verify results (leading edge to leading edge at 50% amplitude points).

SETTING	RESULT
RINGS 2	Two reply pulses are present. Ring 2 reply pulse occurs 200 µs (±20 ns) after Ring 1 reply pulse.
RINGS 3	Three reply pulses are present. Ring 3 reply pulse occurs 200 µs (±20 ns) after Ring 2 reply pulse.
RINGS 4	Four reply pulses are present. Ring 4 reply pulse occurs 200 µs (±20 ns) after Ring 3 reply pulse.
RINGS 5	Five reply pulses are present. Ring 5 reply pulse occurs 200 µs (±20 ns) after Ring 4 reply pulse.

Range Reply Rings Evaluation
Table 3

STEP PROCEDURE

7. Set RANGE 1 DELAY Thumbwheels (37) to various values and verify Range 1 reply rings change accordingly.

8. Set RANGE SEL Switch (39) to ***R2 ON***.

9. Set RD-301A as follows:

CONTROL		SETTING
(31)	PULSE WIDTH µS Control (RANGE 2)	***20***
(35)	PULSE WIDTH MULTIPLIER Control (RANGE 2)	***1***
(38)	RANGE 2 DELAY Thumbwheels	***400.0***

10. Verify Range 2 reply pulse leading edge occurs ≈400 µs after sync pulse leading edge (two major divisions).

11. Set RANGE 2 DELAY Thumbwheels (38) to various values and verify Range 2 reply pulse changes accordingly.

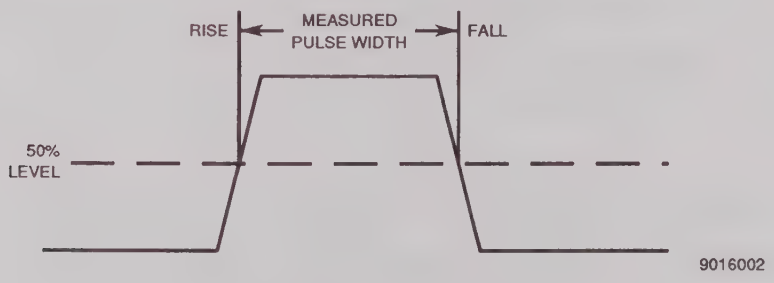
12. Set RD-301A as follows:

CONTROL		SETTING
(32)	PULSE WIDTH µS Control (RANGE 1)	***3***
(34)	PULSE WIDTH MULTIPLIER Control (RANGE 1)	***.1***
(39)	RANGE SEL Switch	***RINGS 1***

13. Set Oscilloscope sweep speed for 0.1 µs/Div and trigger on Channel 1.

NOTE: Refer to 1-2-3, Figure 2 for measuring pulse widths in following steps.

14. Verify reply pulse width is 0.3 µs.



Reply Pulse Width
Figure 2

15. Set PULSE WIDTH MULTIPLIER Control (RANGE 1) (34) to ***1***.

16. Set Oscilloscope sweep speed to 1 µs/Div.

17. Verify reply pulse width is 3 µs.

STEP PROCEDURE

18. Set PULSE WIDTH MULTIPLIER Control (RANGE 1) (34) to ***10***.

19. Set Oscilloscope sweep speed to 10 µs/Div.

20. Verify reply pulse width is 30 µs.

21. Set PULSE WIDTH MULTIPLIER Control (RANGE 1) (34) to ***100***.

22. Set Oscilloscope sweep speed to 100 µs/Div.

23. Verify reply pulse width is 300 µs.

24. Set RD-301A as follows:

CONTROL		SETTING
(31)	PULSE WIDTH µS Control (RANGE 2)	***3***
(35)	PULSE WIDTH MULTIPLIER Control (RANGE 2)	***.1***
(39)	RANGE SEL Switch	***R2 ON***

25. Set Oscilloscope sweep speed for 0.1 µs/Div.

26. Verify Range 2 reply pulse width is 0.3 µs.

27. Set PULSE WIDTH MULTIPLIER Control (RANGE 2) (35) to ***1***.

28. Set Oscilloscope sweep speed to 1 µs/Div.

29. Verify Range 2 reply pulse width is 3 µs.

30. Set PULSE WIDTH MULTIPLIER Control (RANGE 2) (35) to ***10***.

31. Set Oscilloscope sweep speed to 10 µs/Div.

32. Verify Range 2 reply pulse width is 30 µs.

33. Set PULSE WIDTH MULTIPLIER Control (RANGE 2) (35) to ***100***.

34. Set Oscilloscope sweep speed to 100 µs/Div.

35. Verify Range 2 reply pulse width is 300 µs.

36. Disconnect Oscilloscope from RD-301A.

(5) Meter and Tracking Functions

TEST EQUIPMENT: 1 L-Band Signal Generator
1 Oscilloscope
1 Pulse Generator

STEP PROCEDURE

METER FUNCTION

1. With power not applied, verify PANEL Meter (43) indicates zero on KW PEAK scale. If not, adjust PANEL METER ZERO Control (45).

2. Apply power to RD-301A and allow for 30 minute stabilization period.

3. Set RD-301A as follows:

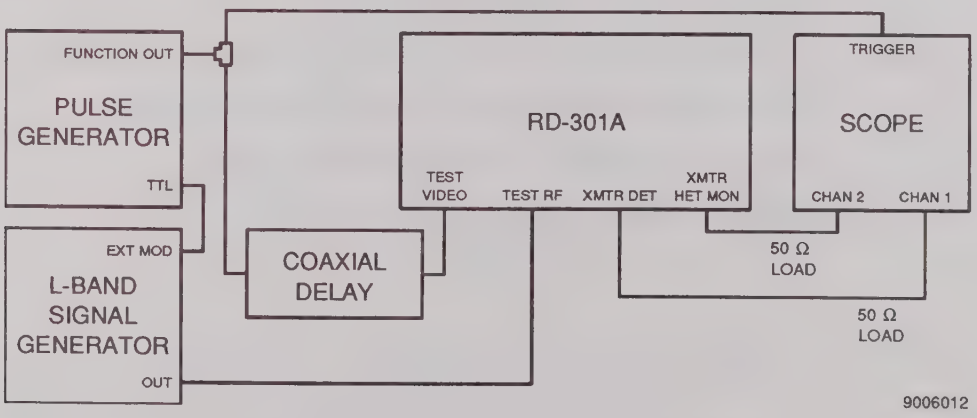
CONTROL	SETTING
(2) PRF/RF Switch	***RF***
(16) RF/IF MODE Pushbutton Switches	***RF TRACK***
(29) MODULATION MODE Pushbutton Switches	***TRACK***

4. Connect Pulse Generator to Oscilloscope with 50 Ω load.

5. Set Pulse Generator with dc offset at ground reference, as follows:

CONTROL	SETTING
Waveform	Positive Pulse
Pulse Width	5 µs
PRF	500
Amplitude	+1.5 V_P

6. Disconnect Pulse Generator from Oscilloscope and connect test equipment as shown in 1-2-3, Figure 3.



Effective Power Evaluation Setup Diagram
Figure 3

STEP PROCEDURE

7. Set L-Band Signal Generator for 1150 MHz at +5 dBm.

8. Set Oscilloscope to view Channels 1 and 2 with fast sweep speed to verify Coaxial Delay.

9. Provide enough Coaxial Delay for XMTR DET Connector (13) output (Channel 1) lead XMTR HET MON Connector (11) output (Channel 2) by ≈12 ns.

10. Set METER SELECT Switch (47) to ***PK POWER***.

11. Verify power level is between ***1*** and ***2 kW*** on PANEL Meter (43).

12. Set METER SELECT Switch (47) to ***EFF POWER***.

13. Verify PANEL Meter (43) displays approximately same level as in Step 11.

14. Set METER SELECT Switch (47) to ***PK POWER***.

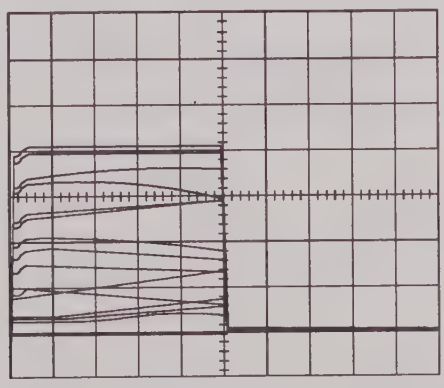
15. Adjust Pulse Generator pulse amplitude down to 0 V_P and verify PANEL Meter (43) reading drops to ***0 kW***.

16. Adjust Pulse Generator pulse amplitude for ***2 kW*** on PANEL Meter (43).

HETERODYNE MONITOR

17. Adjust Oscilloscope sweep speed and amplitude scale to display Channel 2.

18. Verify Oscilloscope displays XMTR HET MON Connector (11) output as pulse envelope filled with lines. Refer to 1-2-4, Figure 4. Lines should be mostly horizontal in nature.



9016007

Heterodyne Monitor L-Band Test Signal
Figure 4

19. Adjust ΔF OFFSET/EFF PEAKING Control (48) ***cw*** and verify lines within pulse envelope change from vertical to horizontal and back to vertical.

STEP PROCEDURE

20. Set ΔF OFFSET/EFF PEAKING Control (48) to ***CAL***.

TRACKING FUNCTION

21. Verify ≈***9400 MHz*** is shown on Frequency Hz/MHz Digital Display (1).

22. Adjust L-Band Signal Generator to 1200 MHz.

23. Verify ≈***9450 MHz*** is shown on Frequency Hz/MHz Digital Display (1).

24. Verify lines within pulse envelope on Oscilloscope remain relatively horizontal.

25. Adjust L-Band Signal Generator for 1150 MHz.

EFFECTIVE POWER

26. Verify power level is ***2 kW*** on PANEL Meter (43). Adjust Pulse Generator pulse amplitude, if necessary.

27. Set METER SELECT Switch (47) to ***ΔF***.

28. Adjust ΔF OFFSET/EFF PEAKING Control (48) for ***+.1 MHz*** offset using ΔF-MHz scale on PANEL Meter (43).

29. Set METER SELECT Switch (47) to ***EFF POWER***.

30. Verify power level is ≈***.8 kW*** (40% operation) on PANEL Meter (43).

31. Set METER SELECT Switch (47) to ***ΔF***.

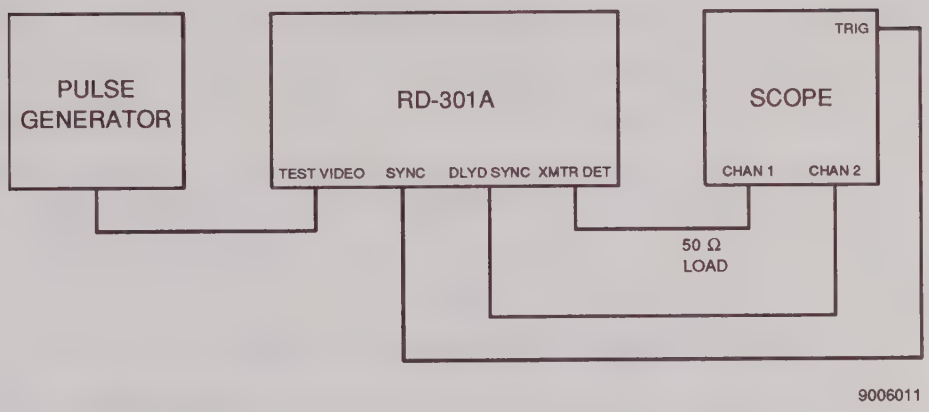
32. Adjust ΔF OFFSET/EFF PEAKING Control (48) for ***-.1 MHz*** offset on PANEL Meter (43).

33. Verify power level is ≈***.8 kW*** (40% operation) on PANEL Meter (43).

34. Disconnect test equipment.

(6) R1,R2 AUTO

TEST EQUIPMENT: 1 Oscilloscope
1 Pulse Generator



R1,R2 AUTO Threshold Evaluation Setup Diagram
Figure 5

STEP PROCEDURE

1. Apply power to RD-301A and allow for 30 minute stabilization period.

2. Set RD-301A as follows:

CONTROL		SETTING
(2)	PRF/RF Switch	***PRF***
(16)	RF/IF MODE Pushbutton Switches	***TRACK***
(29)	MODULATION MODE Pushbutton Switches	***TRACK***
(32)	PULSE WIDTH µS Control (RANGE 1)	***1***
(31)	PULSE WIDTH µS Control (RANGE 2)	***3***
(34)	PULSE WIDTH MULTIPLIER Control (RANGE 1)	***1***
(35)	PULSE WIDTH MULTIPLIER Control (RANGE 2)	***1***
(36)	µS/NM Switch	***µS***
(37)	RANGE 1 DELAY Thumbwheels	***000.5***
(38)	RANGE 2 DELAY Thumbwheels	***011.0***
(39)	RANGE SEL Switch	***R1,R2 AUTO***

3. Connect test equipment as shown in 1-2-3, Figure 5.

4. Set Pulse Generator as follows:

CONTROL	SETTING
Waveform	Positive Pulse
Pulse Width	5 µs
PRF	2000
Amplitude	+3 Vp

STEP PROCEDURE

5. Set Oscilloscope to display both channels (dc coupled) as follows:

CONTROL	SETTING
Channel 1 Amplitude	1 V/Div
Channel 2 Amplitude	1 V/Div
Sweep Speed	2 µs/Div

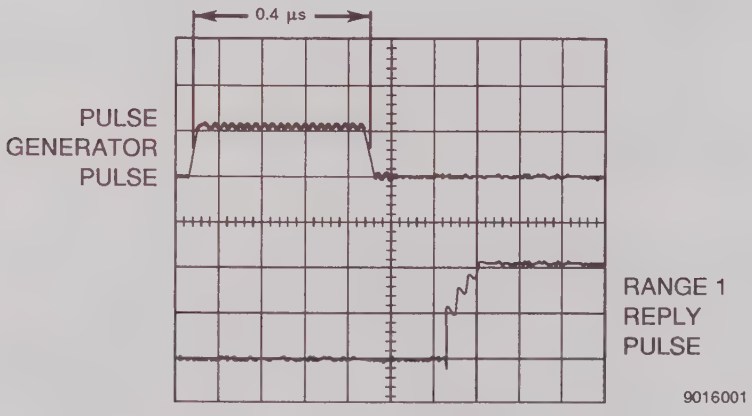
6. Verify Range 2 reply pulse (Channel 2) is ≈11 µs following sync pulse (leading edge to leading edge at 50% amplitude points).

7. Decrease Pulse Generator pulse width until Range 1 reply pulse is displayed on Oscilloscope.

8. Set Oscilloscope sweep speed to 0.1 µs/Div.

9. Refer to 1-2-3, Figure 6. Verify Pulse Generator pulse width is ≈0.4 µs (factory threshold setting).

   NOTE: If threshold setting has been readjusted, Pulse Generator pulse width should approximate new setting.



R1,R2 AUTO Threshold Measurement
Figure 6

10. Disconnect test equipment.

(7) Marker

TEST EQUIPMENT: None

STEP	PROCEDURE

1. Apply power to RD-301A and allow for 30 minute stabilization period.

2. Set RD-301A as follows:

CONTROL	SETTING
(2) PRF/RF Switch	***RF***
(16) RF/IF MODE Pushbutton Switches	***IF LO***

3. Press and hold DISPLAY MKR Switch (21). Verify frequency displayed on FREQUENCY Hz/MHz Digital Display (1) changes.

4. Adjust MKR FREQ Control (19) ***fully cw***.

5. With DISPLAY MKR Switch (21) pressed, verify ≥70 MHz on FREQUENCY Hz/MHz Digital Display (1).

6. Adjust MKR FREQ Control (19) ***fully ccw***.

7. With DISPLAY MKR Switch (21) pressed, verify ≤20 MHz on FREQUENCY Hz/MHz Digital Display (1).

H. Performance Evaluation Data Sheet

TECHNICIAN:_____ DATE:_____

RD-301A S/N:_____

STEP	DATA	RESULT
(1) RF		
3.	RF Indicator (6) illuminates.	_____(√)
	X-BAND SIGNAL Indicator (17) illuminates.	_____(√)
4.	Frequency ≤9295 MHz	_____
6.	Frequency ≥9500 MHz	_____
(2) IF		
5.	IF LO Indicator (8) illuminates.	_____(√)
	IF OUT Indicator (14) illuminates.	_____(√)
6.	Frequency ≥70 MHz	_____
7.	RD-301A Displayed Frequency = Frequency Counter Reading (±7 kHz)	_____
9.	Frequency ≤20 MHz	_____
10.	RD-301A Displayed Frequency = Frequency Counter Reading (±2 kHz)	_____
12.	IF HI Indicator (5) illuminates.	_____(√)
	IF LO Indicator (8) does not illuminate.	_____(√)
(3) PRF		
4.	Frequency ≈50 Hz	_____(√)
5.	RD-301A Displayed Frequency = Frequency Counter Reading (±1 Hz)	_____
7.	Frequency ≥500 Hz	_____
8.	RD-301A Displayed Frequency = Frequency Counter Reading (±1 Hz)	_____
10.	Frequency ≥5000 Hz	_____

STEP	DATA	RESULT
11.	RD-301A Displayed Frequency = Frequency Counter Reading (±2 Hz)	_____
13.	Frequency ≤500 Hz	_____
14.	RD-301A Displayed Frequency = Frequency Counter Reading (±1 Hz)	_____
16.	Frequency 0 Hz	_____ (√)
(4) Range		
5.	Range 1 reply pulse moves right ≈200 µs.	_____ (√)
6.	Ring 2 reply pulse position 200 µs (180 to 220 µs) after Ring 1 reply pulse	_____
	Ring 3 reply pulse position 200 µs (180 to 220 µs) after Ring 2 reply pulse	_____
	Ring 4 reply pulse position 200 µs (180 to 220 µs) after Ring 3 reply pulse	_____
	Ring 5 reply pulse position 200 µs (180 to 220 µs) after Ring 4 reply pulse	_____
7.	Range 1 reply rings vary according to delay setting.	_____ (√)
10.	Range 2 reply pulse position ≈400 µs after sync pulse	_____ (√)
11.	Range 2 reply rings vary according to delay setting.	_____ (√)
14.	Reply pulse width 0.3 µs	_____ (√)
17.	Reply pulse width 3 µs	_____ (√)
20.	Reply pulse width 30 µs	_____ (√)
23.	Reply pulse width 300 µs	_____ (√)
26.	Range 2 reply pulse width 0.3 µs	_____ (√)
29.	Range 2 reply pulse width 3 µs	_____ (√)
32.	Range 2 reply pulse width 30 µs	_____ (√)
35.	Range 2 reply pulse width 300 µs	_____ (√)

STEP	DATA	RESULT

(5) Meter and Tracking Functions

METER FUNCTION

1.	PANEL Meter (43) indicates zero.	_____(√)
11.	Peak Power Level 1 to 2 kW	_____
13.	Effective Power Level ≈Same as Step 11	_____(√)
15.	Peak Power Level decreases to 0 kW.	_____(√)

HETERODYNE MONITOR

18.	XMTR HET MON Connector (11) output Pulse envelope contains lines.	_____(√)
19.	Lines within pulse envelope change nature as Frequency is offset.	_____(√)

TRACKING FUNCTION

21.	Tracking Frequency ≈9400 MHz	_____(√)
23.	Tracking Frequency ≈9450 MHz	_____(√)
24.	XMTR HET MON Connector (11) output Lines within pulse envelope remain relatively horizontal.	_____(√)

EFFECTIVE POWER

26.	Peak Power Level 2 kW	_____(√)
29.	Effective Peak Power Level 0.8 kW	_____
33.	Effective Peak Power Level 0.8 kW	_____

(6) R1,R2 AUTO

6.	Range 2 reply pulse position ≈11 µs after Range 1 reply pulse	_____(√)
9.	Pulse Generator pulse width ≈0.4 µs (or adjusted threshold setting)	_____(√)

(7) Marker

3.	Frequency changes.	_____(√)
5.	Frequency ≥70 MHz	_____
7.	Frequency ≤20 MHz	_____

4. General Operating Procedures

A. General

The General Operating Procedures are a series of instruction sequences for using the RD-301A to test radar systems. The suggested instruction sequences provide a general application of the RD-301A. Some verifications are according to RTCA Document DO-173. Refer to the UUT manual from the radar manufacturer for specifications and detailed test procedures.

TEST FUNCTION PROCEDURE	PAGE
Peak Power and Frequency	4
Range Precision	5
Sensitivity	6
Turbulence Detection	7
Dual Target Simulation	8
Effective Power and Automatic Frequency Control (AFC) Centering	10
Minimum Detection Range (MDR)	11
Sensitivity Time Control (STC)	12
Magnetron Pulse Frequency and Phase Deviation	13
IF Testing	18

B. Pre-Operational Considerations

For maximum benefit, it is strongly recommended that personnel thoroughly read and understand all steps of the Test Function Procedures to be performed, prior to completion.

C. Controls, Connectors and Indicators

RD-301A controls, connectors and indicators are specified with item numbers. The location according to item number of each control, connector and indicator is shown in 1-2-2, Figure 1.

D. Test Equipment Requirements

The test equipment needed to perform the General Operating Procedures is a calibrated RD-301A and Oscilloscope. Appendix B contains a list of test equipment suitable for performing any procedure contained in this manual. Other equipment meeting specifications listed in Appendix B may be substituted for recommended models.

NOTE: For certain procedures, the Oscilloscope listed in Appendix B may exceed the minimum required specifications.

E. Operating Precautions

WARNING: REMOVE ALL JEWELRY OR OTHER COSMETIC APPAREL BEFORE PERFORMING ANY TEST PROCEDURE INVOLVING LIVE CIRCUITS.

WARNING: WHEN WORKING WITH LIVE CIRCUITS OF HIGH POTENTIAL, KEEP ONE HAND IN POCKET OR BEHIND BACK TO AVOID SERIOUS SHOCK HAZARD.

WARNING: USE ONLY INSULATED TROUBLESHOOTING TOOLS WHEN WORKING WITH LIVE CIRCUITS.

WARNING: FOR ADDED INSULATION, PLACE RUBBER BENCH MAT UNDER ALL POWERED BENCH EQUIPMENT AND A RUBBER FLOOR MAT UNDER OPERATOR'S CHAIR.

WARNING: HEED ALL WARNINGS AND CAUTIONS CONCERNING MAXIMUM VOLTAGES AND POWER INPUTS.

F. Test Setup (Refer to 1-2-4, Figure 7.)

NOTE: Calibration of Test Set and appropriate test results are dependent on use of Waveguide Coupler and Serialized Coaxial Cable furnished with RD-301A. any replacement necessitates recalibration.

STEP	PROCEDURE

1. Connect Waveguide Coupler to Radar UUT R/T antenna connector.

   CAUTION: THE SERIALIZED COAXIAL CABLE IS A PRECISION PIECE OF MICROWAVE EQUIPMENT AND CANNOT WITHSTAND ROUGH PHYSICAL USE OR ABUSE.

2. Connect one end of Serialized Coaxial Cable to Waveguide Coupler.

   CAUTION: THE HIGH POWER WAVEGUIDE TERMINATION (DUMMY LOAD) MUST BE ATTACHED TO WAVEGUIDE COUPLER FLANGE MARKED "LOAD" BEFORE PLACING INTO OPERATION.

3. Verify Dummy Load is attached to Waveguide Coupler flange marked "LOAD".

   CAUTION: ANY TRANSMISSION FROM A RADAR UUT R/T RATED ABOVE 12 kW REQUIRES 10 dB ATTENUATION BETWEEN WAVEGUIDE COUPLER AND SERIALIZED COAXIAL CABLE.

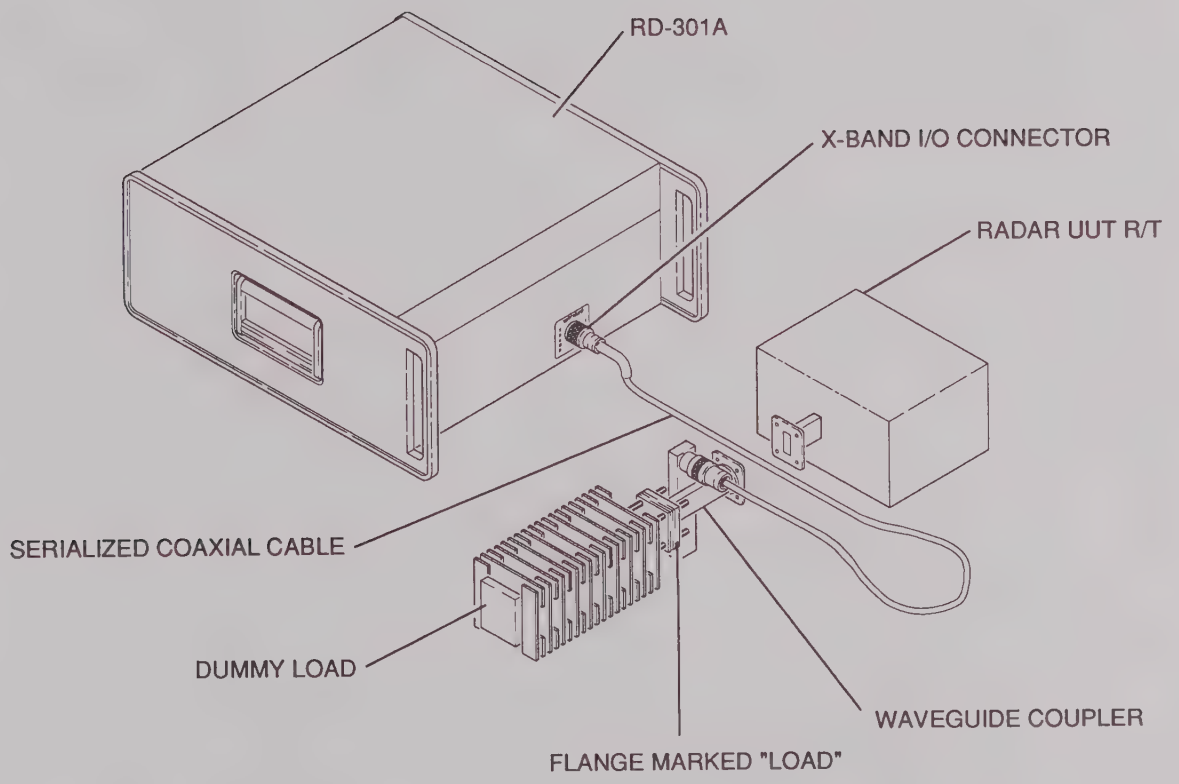
4. If Radar UUT R/T is rated above 12 kW (up to 120 kW), insert 10 dB Attenuator between Serialized Coaxial Cable and Waveguide Coupler.

   NOTE: When 10 dB Attenuator is connected, multiply PANEL Meter (43) KW PEAK scale by ten to obtain correct readings. PANEL Meter (43) full scale becomes 120 kW peak.

   CAUTION: TRANSMISSION INTO X-BAND I/O CONNECTOR (18) MUST NEVER EXCEED 120 W.

5. Connect Serialized Coaxial Cable to X-BAND I/O Connector (18) on RD-301A.

6. Connect Radar UUT system equipment together according to UUT manual.



RD-301A/UUT Interface
Figure 7

G. Test Function Procedures

(1) Peak Power and Frequency

TEST EQUIPMENT: None

STEP	PROCEDURE

1. Perform Test Setup (1-2-4F).
2. Apply power to Radar UUT and RD-301A. Allow 30 minute stabilization period for RD-301A.
3. Select ***RF TRACK*** for Radar UUT R/T rated ≤12 kW or ***RF TRACK -10 dB*** for Radar UUT R/T rated >12 kW using RF/IF MODE Pushbutton Switches (16). RF Indicator (6) or RF -10 dB Indicator (7) illuminates.
4. Set METER SELECT Switch (47) to ***PK POWER***.
5. Verify UUT Peak Power on PANEL Meter (43) using KW PEAK Scale. If 10 dB Attenuator is connected, multiply PANEL Meter (43) reading by ten to obtain UUT Peak Power.
6. Select ***TRACK*** using MODULATION MODE Pushbutton Switches (29). TRACK Indicator (44) illuminates.
7. Verify ΔF OFFSET/EFF PEAKING Control (48) is in ***CAL*** (detent) position. OFFSET Indicator (49) is not illuminated.
8. Set PRF/RF Switch (2) to ***RF***.
9. Verify Radar transmitter frequency on FREQUENCY Hz/MHz Digital Display (1).
10. Set PRF/RF Switch (2) to ***PRF***.
11. Vary range scale settings on Radar UUT Indicator and verify Radar transmitter pulse repetition frequency on FREQUENCY Hz/MHz Digital Display (1).

(2) Range Precision

TEST EQUIPMENT: None

STEP PROCEDURE

1. Perform Test Setup (1-2-4F).

2. Apply power to Radar UUT and RD-301A. Allow 30 minute stabilization period for RD-301A.

3. Select ***RF TRACK*** for Radar UUT R/T rated ≤12 kW or ***RF TRACK -10 dB*** for Radar UUT R/T rated >12 kW using RF/IF MODE Pushbutton Switches (16). RF Indicator (6) or RF -10 dB Indicator (7) illuminates.

4. Set RD-301A controls as follows:

CONTROL		SETTING
(4)	OUTPUT LEVEL FINE dBM Control	***0***
(9)	OUTPUT LEVEL COARSE dBm Control	***-70***
(29)	MODULATION MODE Pushbutton Switches	***TRACK***
(32)	PULSE WIDTH µS Control (RANGE 1)	***5***
(34)	PULSE WIDTH MULTIPLIER Control (RANGE 1)	***1***
(36)	µS/NM Switch	***NM***
(47)	METER SELECT Switch	***ΔF***
(48)	ΔF OFFSET/EFF PEAKING Control	***CAL***

5. Set Radar UUT Indicator to minimum range scale.

6. Set RANGE SEL Switch (39) to number (≤5) of range rings on Radar UUT Indicator.

   NOTE: If more than one Range 1 reply ring is selected by RANGE SEL Switch (39) and the reply is not shown or is distorted on the Radar UUT Indicator, the reply pulse width selected on RD-301A may require adjusting. Pulse width is adjusted using PULSE WIDTH µS Control (RANGE 1) (32) and PULSE WIDTH MULTIPLIER Control (RANGE 1) (34).

7. Adjust RANGE 1 DELAY Thumbwheels (37) until leading edge of first reply ring from Test Set is superimposed over first range ring on Radar UUT Indicator.

8. Verify value shown on RANGE 1 DELAY Thumbwheels (29) equals specified distance between range rings on Radar UUT Indicator (±1 nmi for ranges ≤10 nmi or ±10% of range specified for >10 nmi or according to UUT specifications).

9. Verify reply rings are positioned at each range ring on Radar UUT Indicator.

10. Repeat Steps 6 through 9 for all range scale settings on Radar UUT Indicator.

(3) Sensitivity

TEST EQUIPMENT: None

STEP PROCEDURE

1. Perform Test Setup (1-2-4F).

2. Apply power to Radar UUT and RD-301A. Allow 30 minute stabilization period for RD-301A.

3. Select ***RF TRACK*** for Radar UUT R/T rated ≤12 kW or ***RF TRACK -10 dB*** for Radar UUT R/T rated >12 kW using RF/IF MODE Pushbutton Switches (16). RF Indicator (6) or RF -10 dB Indicator (7) illuminates.

4. Set RD-301A controls as follows:

CONTROL		SETTING
(4)	OUTPUT LEVEL FINE dBM Control	***0***
(9)	OUTPUT LEVEL COARSE dBm Control	***-70***
(23)	INTL AM Switch	***OFF***
(29)	MODULATION MODE Pushbutton Switches	***TRACK***
(32)	PULSE WIDTH µS Control (RANGE 1)	***3.5***
(34)	PULSE WIDTH MULTIPLIER Control (RANGE 1)	***10***
(36)	µS/NM Switch	***µS***
(39)	RANGE SEL Switch	***RINGS 1***

5. Set RANGE 1 DELAY Thumbwheels (37) >Sensitivity Time Control (STC) limits for Radar UUT Indicator.

MINIMUM DISCERNIBLE SIGNAL (MDS)

6. Adjust Radar UUT Indicator to view reply ring.

7. Adjust OUTPUT LEVEL FINE dBm Control (4) and OUTPUT LEVEL COARSE dBm Control (9) until ≈30% of reply ring signal band is illuminated on Radar UUT Indicator.

8. Add OUTPUT LEVEL FINE dBm Control (4) and OUTPUT LEVEL COARSE dBm Control (9) settings with Waveguide Coupler attenuation to obtain MDS level.

INTENSITY LEVELS

9. Set RANGE SEL Switch (39) to ***CONTOUR/AM UP MOD***.

10. Adjust CONTOUR/R2/INTL AM dB BOOST/ATTEN Control (3) from 0 to 20 dB. Monitor Oscilloscope and Radar UUT Indicator for correct intensity/color responses.

11. Verify CONTOUR/R2/INTL AM dB BOOST/ATTEN Control (3) setting (Contour Threshold) relative to MDS at each intensity/color level according to UUT specifications.

(4) Turbulence Detection

TEST EQUIPMENT: None

STEP PROCEDURE

1. Perform Test Setup (1-2-4F).

2. Apply power to Radar UUT and RD-301A. Allow 30 minute stabilization period for RD-301A.

3. Select ***RF TRACK*** for Radar UUT R/T rated ≤12 kW or ***RF TRACK -10 dB*** for Radar UUT R/T rated >12 kW using RF/IF MODE Pushbutton Switches (16). RF Indicator (6) or RF -10 dB Indicator (7) illuminates.

4. Set RD-301A controls as follows:

CONTROL		SETTING
(23)	INTL AM Switch	***INTL AM***
(29)	MODULATION MODE Pushbutton Switches	***TRACK***
(32)	PULSE WIDTH µS Control (RANGE 1)	***5***
(34)	PULSE WIDTH MULTIPLIER Control (RANGE 1)	***1***
(36)	µS/NM Switch	***NM***
(47)	METER SELECT Switch	***ΔF***
(48)	ΔF OFFSET/EFF PEAKING Control	***CAL***

5. Set Radar UUT Indicator for turbulence detection.

6. Set RANGE 1 DELAY Thumbwheels (37) to desired range in nmi.

7. Set RANGE SEL Switch (39) to ***CONTOUR/AM UP MOD*** for up modulation. Set RANGE SEL Switch (39) to any other position for down modulation.

8. Use INTL PRF/AM Control (41) and X1/X10 INTL PRF/AM Switch (42) to set PRF of AM square wave.

9. Adjust OUTPUT LEVEL FINE dBM Control (4) and OUTPUT LEVEL COARSE dBm Control (9) for desired level of Range 1 reply.

10. Adjust CONTOUR/R2/INTL AM dB BOOST/ATTEN Control (3) to set AM level referenced to Range 1 reply level.

    - Set from ***00*** to ***20*** (0 to 20 dB) for up modulation when Range 1 reply level is between -127 to -75 dBm.

    - Set from ***00*** to ***59*** (0 to -59 dB) for down modulation.

11. Verify Radar UUT Indicator displays turbulence according to UUT specifications.

12. For external AM, set INTL AM Switch (23) to ***OFF*** and connect AM source to AM EXT INPUT Connector (53). Refer to 1-2-2 for input requirements.

(5) Dual Target Simulation

TEST EQUIPMENT: None

STEP PROCEDURE

1. Perform Test Setup (1-2-4F).

2. Apply power to Radar UUT and RD-301A. Allow 30 minute stabilization period for RD-301A.

3. Select ***RF TRACK*** for Radar UUT R/T rated ≤12 kW or ***RF TRACK -10 dB*** for Radar UUT R/T rated >12 kW using RF/IF MODE Pushbutton Switches (16). RF Indicator (6) or RF -10 dB Indicator (7) illuminates.

4. Set RD-301A controls as follows:

CONTROL	SETTING
(29) MODULATION MODE Pushbutton Switches	***TRACK***
(36) µS/NM Switch	***µS***
(47) METER SELECT Switch	***ΔF***
(48) ΔF OFFSET/EFF PEAKING Control	***CAL***

5. Adjust PULSE WIDTH µS Control (RANGE 1) (32) and PULSE WIDTH MULTIPLIER Control (RANGE 1) (34) for 5 µs or desired Range 1 reply pulse width (first target simulation).

6. Adjust PULSE WIDTH µS Control (RANGE 2) (31) and PULSE WIDTH MULTIPLIER Control (RANGE 2) (35) for 10 µs or desired Range 2 reply pulse width (second target simulation).

7. Adjust OUTPUT LEVEL FINE dBM Control (4) and OUTPUT LEVEL COARSE dBm Control (9) for desired level of Range 1 reply.

8. Adjust CONTOUR/R2/INTL AM dB BOOST/ATTEN Control (3) to attenuate Range 2 reply level from Range 1 reply level.

9. Set RANGE 1 DELAY Thumbwheels (37) to ***061.8*** (5 nmi) or desired delay, in microseconds, from leading edge of UUT transmitter pulse to first target.

10. Set RANGE 2 DELAY Thumbwheels (38) to ***086.5*** (7 nmi) or desired delay, in microseconds, from leading edge of UUT transmitter pulse to second target.

    NOTE: If the difference between Range 1 and Range 2 delays is not greater than the Range 1 reply pulse width, Range 1 reply overlays Range 2 reply.

11. Set RANGE SEL Switch (39) to ***R2 ON***.

12. Verify Radar UUT Indicator displays target rings at Step 9 and Step 10 ranges according to UUT specifications.

STEP PROCEDURE

13. Set RANGE SEL Switch (39) to ***R2 ALT*** to have Range 1 replies for every UUT transmitter pulse Range 2 replies for every other (or alternate) UUT transmitter pulse.

14. Verify Radar UUT Indicator displays target rings at Step 9 range every sweep and Step 10 range every other sweep according to UUT specifications.

15. Set RANGE SEL Switch (39) to ***R1, R2 AUTO*** to have RD-301A reply with either Range 1 or Range 2 reply pulse depending on UUT transmitter pulse width. Range 1 reply is transmitted when UUT transmitter pulse width is less than threshold (factory calibrated at 0.4 µs). Range 2 reply is transmitted if UUT transmitter pulse width is greater than threshold.

    NOTE: Range delays for both Range 1 and Range 2 replies must be greater than threshold. If Range 1 delay is set below threshold, Range 1 always responds. If Range 2 delay is below threshold, Range 2 never responds.

16. Verify Radar UUT Indicator displays target ring at Step 9 range or Step 10 range according to UUT transmitter pulse width.

(6) Effective Power and Automatic Frequency Control (AFC) Centering

NOTE: Suggested performance with 1-2-4G(9). Shown separate for clarity.

TEST EQUIPMENT: None

STEP PROCEDURE

1. Perform Test Setup (1-2-4F).

2. Apply power to Radar UUT and RD-301A. Allow 30 minute stabilization period for RD-301A.

3. Select ***RF TRACK*** for Radar UUT R/T rated ≤12 kW or ***RF TRACK -10 dB*** for Radar UUT R/T rated >12 kW using RF/IF MODE Pushbutton Switches (16). RF Indicator (6) or RF -10 dB Indicator (7) illuminates.

4. Set Radar UUT for transmitter pulse width ≥5 μs and ≤10 μs.

5. Set RD-301A controls as follows:

CONTROL		SETTING
(2)	PRF/RF Switch	***RF***
(29)	MODULATION MODE Pushbutton Switches	***TRACK***
(39)	RANGE SEL Switch	***RINGS 1***
(47)	METER SELECT Switch	***PK POWER***
(48)	ΔF OFFSET/EFF PEAKING Control	***CAL***

6. Determine UUT Peak Power on PANEL Meter (43) using KW PEAK Scale. If 10 dB Attenuator is connected, multiply PANEL Meter (43) reading by ten to obtain UUT Peak Power.

7. Set METER SELECT Switch (47) to ***EFF POWER***.

8. When EFF READY Indicator (46) illuminates, determine UUT Effective Peak Power on PANEL Meter (43) using KW PEAK Scale. Multiply PANEL Meter (43) reading by ten to obtain UUT Effective Peak Power if 10 dB Attenuator is connected. Refer to 1-2-4H for power percentage.

AFC CENTERING

9. Adjust ΔF OFFSET/EFF PEAKING Control (48) out of ***CAL*** position for highest possible Effective Peak Power reading on PANEL Meter (43).

10. Set METER SELECT Switch (47) to ***ΔF***.

11. Determine frequency offset on PANEL Meter (43) using ΔF-MHz Scale. Positive needle deflection indicates UUT Radar R/T center frequency is too low (add frequency offset). Negative needle deflection indicates UUT R/T center frequency is too high (subtract frequency offset).

12. Add or subtract frequency offset from Step 11 with FREQUENCY Hz/MHz Digital Display (1) reading to determine center frequency for AFC alignment. Refer to 1-2-4G(9) for AFC alignment.

(7) Minimum Detection Range (MDR)

TEST EQUIPMENT: 1 Oscilloscope

STEP PROCEDURE

1. Perform Test Setup (1-2-4F).

2. Apply power to Radar UUT and RD-301A. Allow 30 minute stabilization period for RD-301A.

3. Select ***RF TRACK*** for Radar UUT R/T rated ≤12 kW or ***RF TRACK -10 dB*** for Radar UUT R/T rated >12 kW using RF/IF MODE Pushbutton Switches (16). RF Indicator (6) or RF -10 dB Indicator (7) illuminates.

4. Set RD-301A controls as follows:

CONTROL		SETTING
(29)	MODULATION MODE Pushbutton Switches	***TRACK***
(36)	µS/NM Switch	***NM***
(37)	RANGE 1 DELAY Thumbwheels	***010.0***
(39)	RANGE SEL Switch	***RINGS 1***
(47)	METER SELECT Switch	***ΔF***
(48)	ΔF OFFSET/EFF PEAKING Control	***CAL***

5. Adjust PULSE WIDTH µS Control (RANGE 1) (32) and PULSE WIDTH MULTIPLIER Control (RANGE 1) (34) to set Range 1 reply pulse width equal to Radar UUT transmitter pulse width.

6. Adjust OUTPUT LEVEL FINE dBM Control (4) and OUTPUT LEVEL COARSE dBm Control (9) to set Range 1 reply level equal to 30% of UUT limiting level. (Refer to UUT manual.)

7. Disable Radar UUT Sensitivity Time Control (STC) circuitry.

8. Set Radar UUT Indicator to ≈10 nmi range limit. Verify Range 1 reply ring signal is shown on Radar UUT Indicator.

9. Decrease RANGE 1 DELAY Thumbwheels (37) until Radar UUT Indicator displays ≈30% of reply ring signal band (MDS level is reached).

10. Verify MDR, RANGE 1 DELAY Thumbwheels (37) setting, is ≤2 nmi.

11. Connect SYNC Connector (26) to Oscilloscope Channel 1. Connect DLYD SYNC Connector (24) to Oscilloscope Channel 2.

12. Set Oscilloscope to trigger on Channel 1 and display both pulses.

13. Verify spacing from SYNC Connector (26) pulse leading edge (Radar UUT transmitter pulse start time) to DLYD SYNC Connector (24) pulse leading edge (reply pulse start time) at 50% points.

14. Disconnect test equipment.

(8) Sensitivity Time Control (STC)

TEST EQUIPMENT: 1 Oscilloscope

STEP PROCEDURE

1. Perform Test Setup (1-2-4F).

2. Apply power to Radar UUT and RD-301A. Allow 30 minute stabilization period for RD-301A.

3. Select ***RF TRACK*** for Radar UUT R/T rated ≤12 kW or ***RF TRACK -10 dB*** for Radar UUT R/T rated >12 kW using RF/IF MODE Pushbutton Switches (16). RF Indicator (6) or RF -10 dB Indicator (7) illuminates.

4. Set RD-301A controls as follows:

CONTROL		SETTING
(29)	MODULATION MODE Pushbutton Switches	***TRACK***
(36)	µS/NM Switch	***NM***
(39)	RANGE SEL Switch	***RINGS 1***
(47)	METER SELECT Switch	***ΔF***
(48)	ΔF OFFSET/EFF PEAKING Control	***CAL***

5. Adjust PULSE WIDTH µS Control (RANGE 1) (32) and PULSE WIDTH MULTIPLIER Control (RANGE 1) (34) to set Range 1 reply pulse width equal to Radar UUT transmitter pulse width.

6. Set RANGE 1 DELAY Thumbwheels (37) to maximum range of STC on Radar UUT.

7. Connect XMTR DET Connector (13) to Oscilloscope Channel 1 with 50 Ω load. Connect DLYD SYNC Connector (24) to Oscilloscope Channel 2.

8. Set Oscilloscope to trigger on Channel 2 and display level of Radar UUT transmitter pulse.

9. Adjust OUTPUT LEVEL FINE dBM Control (4) and OUTPUT LEVEL COARSE dBm Control (9) until transmitter pulse level displayed on Oscilloscope equals reply pulse level (OUTPUT LEVEL FINE dBM Control [4] and OUTPUT LEVEL COARSE dBm Control [9] settings added to Waveguide Coupler attenuation). Verify and record level.

10. Repeat Steps 6 through 9 for six equally spaced ranges within STC operational limits of Radar UUT.

11. Disconnect test equipment.

(9) Magnetron Pulse Frequency and Phase Deviation

NOTE: Suggested performance with 1-2-4G(6). Shown separate for clarity.

TEST EQUIPMENT: 1 Oscilloscope

STEP PROCEDURE

1. Perform Test Setup (1-2-4F).

2. Apply power to Radar UUT and RD-301A. Allow 30 minute stabilization period for RD-301A.

3. Select ***RF TRACK*** for Radar UUT R/T rated ≤12 kW or ***RF TRACK -10 dB*** for Radar UUT R/T rated >12 kW using RF/IF MODE Pushbutton Switches (16). RF Indicator (6) or RF -10 dB Indicator (7) illuminates.

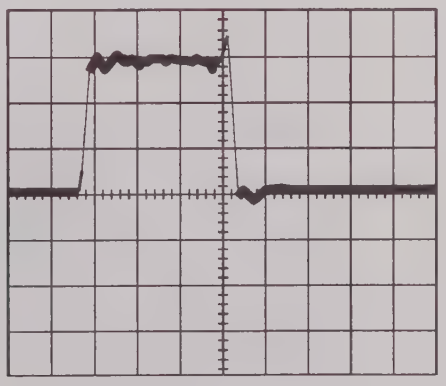
4. Set RD-301A controls as follows:

CONTROL		SETTING
(2)	PRF/RF Switch	***RF***
(29)	MODULATION MODE Pushbutton Switches	***TRACK***
(36)	µS/NM Switch	***µS***
(37)	RANGE 1 DELAY Thumbwheels	***024.0***
(39)	RANGE SEL Switch	***RINGS 1***
(48)	ΔF OFFSET/EFF PEAKING Control	***CAL***

DISCRIMINATOR PULSE (FREQUENCY DEVIATION)

5. Connect XMTR DSCRM .1V/MHz Connector (12) to Oscilloscope Channel 1 with 50 Ω load. Connect DLYD SYNC Connector (24) to Oscilloscope Channel 2.

6. Set Oscilloscope to trigger on Channel 2 and display level of 5 µs wide discriminator pulse. Refer to 1-2-4, Figure 8 for example discriminator pulse with Oscilloscope set at 3 mV/Div.



9016006

Discriminator Pulse
Figure 8

STEP PROCEDURE

7. Determine frequency deviation during Radar UUT transmitter pulse. Voltage level changes during discriminator pulse, displayed on Oscilloscope, reflect changes in frequency during Radar UUT transmitter pulse. Reference or average voltage corresponds to frequency shown on Frequency Hz/MHz Digital Display (1). One millivolt of level change represents 10 kHz of frequency change.

   NOTE: Adjust RANGE 1 DELAY Thumbwheels (37) to set Oscilloscope trigger for greater time base resolution.

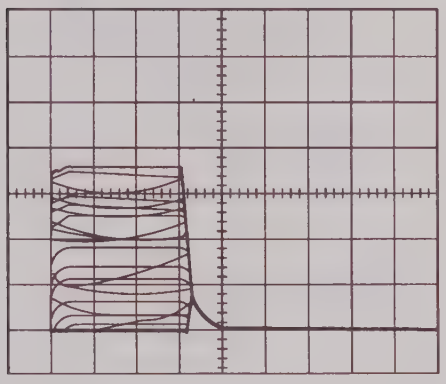
HETERODYNE MONITOR (FREQUENCY AND PHASE DEVIATION)

8. Disconnect XMTR DSCRM .1V/MHz Connector (12) from Oscilloscope Channel 1. Disconnect DLYD SYNC Connector (24) from Oscilloscope Channel 2.

9. Connect XMTR HET MON Connector (11) to Oscilloscope Channel 1 with 50 Ω load. Connect XMTR DET Connector (13) to Oscilloscope Channel 2 with 50 Ω load.

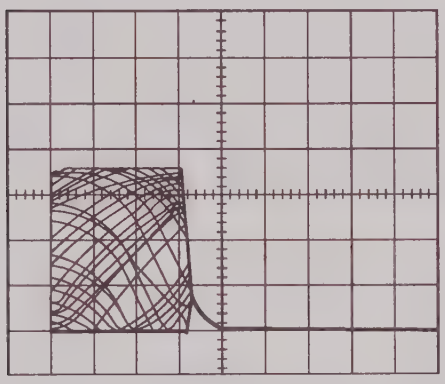
10. Set Oscilloscope to trigger on Channel 2 and display Channel 1. Refer to 1-2-4, Figure 9 for example of XMTR HET MON Connector (11) output. Example Radar UUT transmitter pulse is 1.6 µs wide.

    NOTE: The RD-301A compares or frequency beats the Radar UUT transmitter pulse signal with the internal RF signal generator CW signal. When the frequencies match, a zero beat note is produced at the XMTR HET MON Connector (11). The signal appears on the Oscilloscope as a pulse envelope containing vertically random, horizontal lines. The random vertical dc level, dependent on the finite frequency synchronizing between the two input signals at each pulse occurrence, is set instantaneously. As the two signals become different in frequency, the horizontal lines begin to slope up and down crossing each other, appearing as a cross-hatch pattern on the Oscilloscope. Refer to 1-2-4, Figure 10. The frequency beating technique (heterodyning) is very accurate in comparing frequencies. Application, dependent somewhat on radar transmitter frequency stability, resolves a few kilohertz in a 5 µs pulse. Short term frequency variations during transmitter magnetron pulses are identified using an Oscilloscope display of the XMTR HET MON Connector (11) output. An abrupt frequency variation (magnetron mode splitting) is displayed with a vertical fine line between two different patterns (i.e., cross-hatch/horizontal lines). Refer to 1-2-4, Figure 11. The degree of frequency shift and time duration of the modes are measured using the ΔF OFFSET/EFF PEAKING Control (48) while observing the XMTR HET MON Connector (11) output. When both input signals are at zero beat, Amplitude Modulation plus any Phase Modulation is shown at the peak of the envelope. The AM response diminishes as the beat notes occur more towards the base line revealing phase response only at the base line. The RD-301A and Oscilloscope identify the location and magnitude of phase pulling within the magnetron pulse.



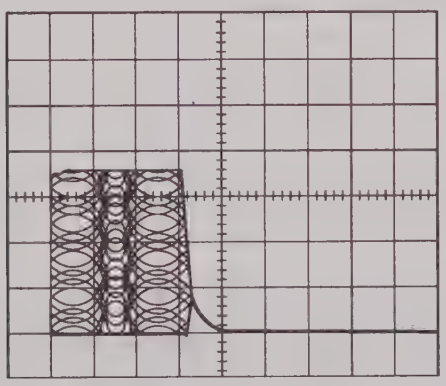
9016003

Heterodyne Monitor Output (Aligned Radar)
Figure 9



9016004

Heterodyne Monitor Output (Frequency Deviation)
Figure 10



9016005

Heterodyne Monitor Output (Mode Split)
Figure 11

STEP PROCEDURE

12. Set METER SELECT Switch (47) to ΔF.

13. Adjust ΔF OFFSET/EFF PEAKING Control (48) out of ***CAL*** position until XMTR HET MON Connector (11) output lines displayed on Oscilloscope are mostly horizontal and parallel to each other.

    NOTE: Usually, one offset frequency will not resolve all frequency and phase deviations in the Radar UUT transmitter pulse. Different sections are analyzed to find frequency and phase errors. The RD-301A and Oscilloscope reveal the frequency and phase characteristics of the Radar UUT transmitter pulse to provide location and amount of correction needed in the magnetron pulse.

14. Determine frequency offset on PANEL Meter (43) using ΔF-MHz Scale. Positive needle deflection indicates Radar UUT transmitter pulse frequency is too low (positive correction or negative error) Subtract frequency offset to determine frequency of pulse section in error. Add frequency offset to determine best corrective frequency. Negative needle deflection indicates Radar UUT transmitter pulse frequency is too high (negative correction or positive error). Add frequency offset to determine frequency of pulse section in error. Subtract frequency offset to determine best corrective frequency.

15. Add or subtract frequency offset from Step 14 with FREQUENCY Hz/MHz Digital Display (1) reading to determine Radar UUT transmitter pulse frequency for section being analyzed.

    NOTE: Best corrective frequencies should closely match each other and AFC center frequency determined in 1-2-4G(6).

    AFC ALIGNMENT

16. Select ***RF MNL*** for Radar UUT R/T rated ≤12 kW or ***RF MNL -10 dB*** for Radar UUT R/T rated >12 kW on RF/IF MODE Pushbutton Switches (16).

17. Set METER SELECT Switch (47) to ***EFF POWER*** and ΔF OFFSET/EFF PEAKING Control (48) to ***CAL***.

18. Adjust MNL FREQ Controls (10) until AFC center frequency determined in 1-2-4G(6) and/or Step 15 is shown on FREQUENCY Hz/MHz Digital Display (1).

19. Align Radar UUT AFC center frequency for highest possible Effective Peak Power reading on PANEL Meter (43) and XMTR HET MON Connector (11) output lines displayed on Oscilloscope are mostly horizontal and parallel to each other.

STEP	PROCEDURE

RADAR UUT TRANSMITTER PULSE WIDTH

20. Set Oscilloscope to display only Channel 2.

21. Verify Radar UUT transmitter pulse width according to UUT specifications. Pulse width must be ≤2.5% of time base range in use on Radar UUT or ≤20 µs, whichever is greater.

RADAR UUT TRANSMITTER PULSE COMPARISON

22. Set Oscilloscope to display both channels.

23. Compare detected Radar UUT transmitter pulse with frequency and phase characterized heterodyne pulse. Verify envelopes match.

24. Disconnect test equipment.

(10) IF Testing

TEST EQUIPMENT: 1 Oscilloscope

STEP	PROCEDURE

1. Perform Test Setup (1-2-4F).

2. Apply power to Radar UUT and RD-301A. Allow 30 minute stabilization period for RD-301A.

3. Connect IF OUT Connector (15) to 50 Ω load at IF input on Radar UUT receiver or desired application connector.

4. Select ***IF LO*** for IF signal from -132 to -20 dBm or ***IF HI*** for IF signal from -92 to +20 dBm using RF/IF MODE Pushbutton Switches (16). IF LO Indicator (8) or IF HI Indicator (5) illuminates.

   NOTE: RD-301A produces IF or X-Band signals but not both at the same time.

5. For Radar UUT receiver selectivity test, connect Oscilloscope Channel 1 to detector output of Radar UUT IF receiver.

6. For Radar UUT receiver selectivity test or IF sweep operation, connect Oscilloscope Channel 2 to IF SCP SWP Connector (20).

7. Adjust OUTPUT LEVEL FINE dBM Control (4) and OUTPUT LEVEL COARSE dBm Control (9) for desired IF level.

8. Adjust MNL FREQ Controls (10) for desired frequency from 20 to 70 MHz. For Radar UUT receiver selectivity test, set frequency for maximum signal on Oscilloscope (≥10 dB down from Radar UUT receiver overload level). Record level for reference.

9. Set MODULATION MODE Pushbutton Switches (29) to:

   - ***TRACK*** for IF signal, modulated by Radar UUT transmitter pulse.
   - ***INTL*** for IF signal, modulated by internal pulse. Use INTL PRF/AM Control (41) and X1/X10 INTL PRF/AM Switch (42) to set internal pulse modulation.
   - ***CW*** for continuous wave IF signal used in Radar UUT receiver selectivity test and IF sweep operation.
   - ***EXT (+)*** for IF signal, modulated by external 2 to 25 V_P pulse rising edge or positive half of sine wave. Connect external source to EXT TRIG Connector (22).
   - ***EXT (-)*** for IF signal, modulated by external 2 to 25 V_P pulse falling edge or negative half of sine wave. Connect external source to EXT TRIG Connector (22).

STEP PROCEDURE

SWEEP

10. Adjust SWEEP WIDTH MHz Control (33) for desired sweep width from 0 to 4 MHz.

RECEIVER SELECTIVITY

11. Use OUTPUT LEVEL FINE dBM Control (4) and OUTPUT LEVEL COARSE dBm Control (9) to decrease attenuation 3 dB from level set in Step 7 (increasing IF signal level 3 dB).

12. Adjust MNL FREQ Controls (10) ***cw*** until signal level on Oscilloscope is same as in Step 8.

13. Record frequency shown on FREQUENCY Hz/MHz Digital Display (1).

14. Adjust MNL FREQ Controls (10) ***ccw*** until signal level on Oscilloscope is same as in Step 12.

15. Record frequency shown on FREQUENCY Hz/MHz Digital Display (1).

16. Verify difference between frequency in Step 15 from frequency in Step 13 Radar UUT receiver bandwidth) is within UUT specifications.

MARKER

17. With DISPLAY MKR Switch (21) pressed, adjust MKR FREQ Control (19) to desired marker signal frequency shown on FREQUENCY Hz/MHz Digital Display (1).

18. Press DISPLAY MKR Switch (21) to add IF marker signal (≈-20 dBc) to IF output.

19. Disconnect test equipment.

H. UUT Power Percentage

Divide UUT Effective Peak Power from 1-2-4G(6), Step 8 by UUT Peak Power from 1-2-4G(6), Step 6 and multiply by 100 to obtain power percentage Radar UUT is operating at.

Equation: $\frac{UUT\ Effective\ Peak\ Power}{UUT\ Peak\ Power} \times 100$

Example: 1-2-3(5)

$\frac{0.8\ kW}{2\ kW} \times 100$

0.4×100

40%

A Radar UUT operates at 40% when it has an Effective Peak Power of 0.8 kW with a Peak Power of 2 kW.

SECTION 3 - SPECIFICATIONS

1. RD-301A Radar Test Set Specifications

NOTE: Specifications and features are subject to change without notice.

A. RF Signal Generator

Frequency: Variable from 9.295 to 9.500 GHz

Tracking:

UUT Frequency: 9.295 to 9.500 GHz

UUT Power: 0.1 to 12 kW

Accuracy:

UUT PULSE WIDTH	ACCURACY
2 to 30 µs	±25 kHz
0.5 to <2 µs	±60 kHz
0.1 to <0.5 µs	±600 kHz
0.05 to <0.1 µs	±2 MHz

ΔF Offset: ±0.75 MHz from tracking frequency

Accuracy: ±20 kHz + 10% of ΔF offset PANEL Meter reading

Output Power: Variable from -127 to -50 dBm (at UUT)

Step: 1 or 10 dB

Accuracy: ±2 dB

Contour Boost: Variable from 0 to 20 dB above selected RF Output level between -127 to -75 dBm

Accuracy: ±1 dB from 9.310 to 9.410 GHz

Range 2 Attenuation: Variable from 0 to 59 dB below selected RF Output level (Range 1) (≥-127 dBm)

Step: 1 dB

Accuracy: ±1.5 dB

RF Pulse Width: Variable from 0.05 to 500 µs

RF ON/OFF Ratio: ≥70 dB

Source VSWR at Waveguide Coupler: ≤1.25:1

B. IF Signal Generator

Frequency:	Variable from 20 to 70 MHz
Sweep Width:	Variable from 0 to 4 MHz
Marker Frequency:	Variable from 20 to 70 MHz
Power:	Variable from -130 to +20 dBm
Step:	1 or 10 dB
Accuracy:	±2.5 dB + 1% of selected level
Pulse Width:	Variable from 0.5 to 500 µs
ON/OFF Ratio:	≥48 dB

C. Modulation

Track:	PRF same as UUT (50 Hz to 20 kHz)
INTL (Internal):	Variable PRF from 50 to 5000 Hz
Internal AM (square wave):	
Frequency:	Variable from 50 Hz to 5 kHz
Square Wave Duty Cycle:	50%
Accuracy:	±2.5%
Amplitude:	
Up Modulation:	Variable from 0 to +20 dB
Step:	1 or 10 dB
Accuracy:	±1 dB for selected RF Output level between -127 to -75 dBm (9.295 to 9.500 GHz)
Down Modulation:	Variable from 0 to -59 dB
Step:	1 or 10 dB
Accuracy:	±1.5 dB for selected RF Output level above -127 dBm (9.295 to 9.500 GHz)

D. Range

Range 1:	0.1 to 999.9 µs or nmi (NM) referenced to leading edge of detected UUT pulse at 50% point
Residual delay:	0 to 0.2 µs
Range 2:	0.1 to 999.9 µs or nmi (NM) referenced to leading edge of detected UUT pulse at 50% point
Residual delay:	0.3 to 0.5 µs
Range Accuracy:	Residual delay ±0.01% of selected range delay (Range delay is referenced to 12.3589 µs/nmi.)
Modes:	
CONTOUR:	Refer to RF Signal Generator, Contour Boost.
RINGS 1 through 5:	Selectable multiples of Range 1
R2 ON:	Range 1 and Range 2 active.
R2 ALT:	Range 1 active with Range 2 active every other detected Radar transmitter pulse.
R1,R2 AUTO:	Range 1 or Range 2 active according to detected radar transmitter pulse width. Range 1 active when Radar transmitter pulse width is <Threshold. Range 2 active when Radar transmitter pulse width is ≥Threshold.
Threshold:	Variable from 0.2 to 1.0 µs (Preset for 0.4 µs)

E. Frequency Counter

RF:	
Resolution:	10 kHz
Accuracy:	±250 kHz
IF:	
Resolution:	1 kHz
Accuracy:	±0.01% of FREQUENCY Hz/MHz Digital Display reading
PRF:	
Resolution:	1 Hz
Accuracy:	±1 Hz + 0.01% of FREQUENCY Hz/MHz Digital Display reading

F. Power Meter

Range:	0.1 kW to 12 kW peak (standard) 1.0 kW to 120 kW peak (option with external 10 dB Attenuator, not calibrated in system)
Accuracy:	±0.6 dB from 1 to 12 kW peak (standard) (at UUT)
Load VSWR:	≤1.25:1

G. Outputs

ANLYZER RF X-BAND XMTR Connector:	Radar transmitter signal
Level:	56 to 68 dB below radar transmitter level
DLYD SYNC Connector:	Positive pulse coincident with reply pulse (Range 1 and/or Range 2)
XMTR DET Connector:	Detected Radar transmitter pulse
Level:	0 to +3 Vdc_P Video into 50 Ω
XMTR DSCRM .1V/MHz Connector:	0.1 V/MHz (±10%) into 50 Ω
XMTR HET MON Connector:	
Level:	0 to <+0.5 Vdc_P into 50 Ω
SYNC Connector:	Positive pulse
Position:	Dependent on MODULATION MODE Pushbutton Switches selection: ***TRACK***Coincident with Radar transmitter pulse ***INTL***Coincident with internal pulse ***EXT (+)***Coincident with external trigger ***EXT (-)***Coincident with external trigger

H. Inputs

AM EXT INPUT Connector: External AM

Input Impedence: >10 kΩ, ac coupled

Input Voltage: 3 V_{P-P} for 28 to 32% modulation

3 dB Bandwidth at 30% AM: ≥4970 Hz (30 Hz to 5 kHz)

AM Percent Limit: 0% to 50%

Square Wave Modulation (typical values):

FREQUENCY	MODULATION	RISE TIME	FALL TIME
500 Hz	50% (10 dB)	28 µs	60 µs
500 Hz	30% (6 dB)	24 µs	40 µs

EXT TRIG Connector: ac coupled, + or -

Level: 2 to 25 V_P

Frequency: 50 Hz to 20 kHz

I. Power

AC INPUT Connector:

Voltage: 103 to 253 VAC

Frequency: 50 to 440 Hz

Power Consumption ≤150 W

THIS PAGE INTENTIONALLY LEFT BLANK.

SECTION 4 - SHIPPING

1. General

The following information applies to shipping and repacking procedures for the Test Set.

A. Shipping Information

IFR Test Sets returned to factory for calibration, service or repair must be repackaged and shipped subject to the following conditions:

(1) Authorization

Do not return products to factory without authorization from IFR Customer Service Department.

CONTACT: IFR Systems, Inc.
Customer Service Dept.
10200 West York Street
Wichita, Kansas 67215

Telephone: 800-835-2350
TWX: 910-741-6952

(2) Tagging Test Sets

All test sets must be tagged with:

- Owner's identification and address.
- Nature of service or repair required.
- Model No.
- Serial No.

(3) Shipping Containers

Test Sets must be repackaged in original shipping containers using IFR packing molds. If original shipping containers and materials are not available, contact IFR Customer Service Dept. for shipping instructions.

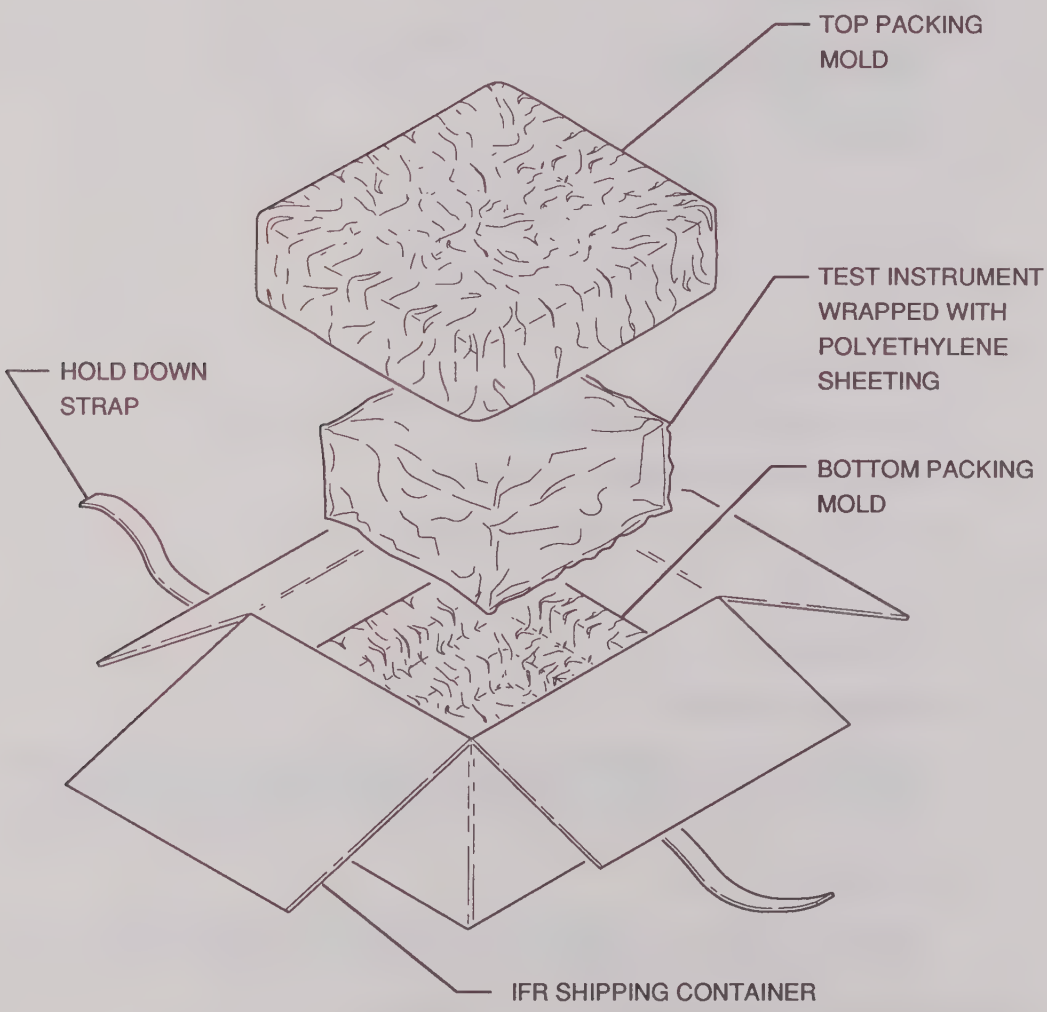
(4) Freight Costs

All freight costs on non-warranty shipments are assumed by customer. (See "Warranty Packet" for freight charge policy on warranty claims.)

B. Repacking Procedure (Refer to 1-4-1, Figure 1.)

- Make sure bottom packing mold is seated on floor of shipping container.
- Carefully wrap Test Set with polyethylene sheeting to protect finish.

- Place Test Set into shipping container, making sure Test Set is securely seated in bottom packing mold.
- Place top packing mold over top of Test Set and press down until mold rests solidly in bottom packing mold.
- Close shipping container lids and seal with shipping tape or an industrial stapler. Tie all sides of container with break resistant rope, twine or equivalent.



Repacking Procedure
Figure 1

APPENDIX A - I/O CONNECTORS AND PIN-OUT TABLE

CONNECTOR	SIGNAL NAME	TYPE	INPUT/OUTPUT	SIGNAL TYPE
J49002	AUX X-BAND	SMA	OUTPUT	RF (X-Band)
J49003	ANLYZER RF X-BAND XMTR	N	OUTPUT	Attenuated Radar UUT Signal
J49004	VCO L-BAND	SMA	OUTPUT	RF (L-Band)
J49005	AM EXT	BNC	INPUT	External AM
J49006	FM EXT	BNC	INPUT	External FM
J49007	50% VIDEO XMTR	BNC	OUTPUT	TTL Video
J49008	AC	ac Male	INPUT	ac Line Power
J49012	IF SCP SWP	BNC	OUTPUT	5 V_{P-P}, 100 Hz
J49016	X-BAND	N	INPUT/OUTPUT	RF (X-Band)
J49020	TEST VIDEO	BNC	INPUT	External Pulse
J49021	TEST RF	BNC	INPUT	RF (L-Band)
J49022	SYNC	BNC	OUTPUT	TTL
J49023	DLYD SYNC	BNC	OUTPUT	TTL
J49024	EXT TRIG	BNC	OUTPUT	2 to 25 V_P Pulse or Sine Wave
J49025	IF	BNC	OUTPUT	IF
J49026	XMTR DET	BNC	OUTPUT	Detected Radar UUT Pulse Signal
J49027	XMTR DSCRM .1V/MHz	BNC	OUTPUT	Reference Pulse (Amplitude Reflects UUT Frequency)
J49028	XMTR HET MON	BNC	OUTPUT	Radar UUT Pulse Modulation

THIS PAGE INTENTIONALLY BLANK.

APPENDIX B - TEST EQUIPMENT REQUIREMENTS

1. General

This Appendix contains a list of test equipment suitable for performing all testing procedures contained in this manual. Other equipment meeting specifications listed in this Appendix may be substituted in place of recommended models. Equipment listed in this Appendix may exceed minimum required specifications for some procedures contained in this manual.

2. Recommended Test Equipment

TYPE	MODEL	SPECIFICATIONS
Frequency Counter	PM 6662 or Equivalent	Frequency Range: 15 to 75 MHz <500 to >5000 Hz (PRF) Accuracy: ≤±1 kHz ≤±0.5 Hz (PRF)
L-Band Signal Generator	FLUKE 6062A or Equivalent	Frequency Range: 1000 to 1200 MHz Resolution: 20 Hz Amplitude: -137 to +13 dBm Accepts external pulse modulation
Oscilloscope	TEK 2465 or Equivalent	Bandwidth: dc to 100 MHz Vertical Accuracy: ±10% Time Accuracy: ±0.7% of Time Interval +0.6% of Full Scale
Pulse Generator	WAVETEK 145 or Equivalent	Frequency Range: 0 to ≥2000 Hz Pulse Width: 0 to ≥5 µs Output Level: 0 to ≥3 V_P

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX C - METRIC/BRITISH IMPERIAL CONVERSION TABLE WITH NAUTICAL DISTANCE CONVERSIONS

TO CONVERT:	INTO:	MULTIPLY BY:	TO CONVERT:	INTO:	MULTIPLY BY:
cm	feet	0.03281	meters	feet	3.281
cm	inches	0.3937	meters	inches	39.37
feet	cm	30.48	m/sec	ft/sec	3.281
feet	meters	0.3048	m/sec	km/hr	3.6
ft/sec	km	1.097	m/sec	miles/hr	2.237
ft/sec	knots	0.5921	miles	feet	5280
ft/sec	miles/hr	0.6818	miles	km	1.609
ft/sec^2	cm/sec^2	30.48	miles	meters	1609
ft/sec^2	m/sec^2	0.3048	miles	nmi	0.8684
grams	ounces	0.03527	miles/hr	ft/sec	1.467
inches	cm	2.54	miles/hr	km/hr	1.609
kg	pounds	2.205	miles/hr	knots	0.8684
kg/cm^2	psi	0.0703	nmi	feet	6080.27
km	feet	3281	nmi	km	1.8532
km	miles	0.6214	nmi	meters	1853.2
km	nmi	0.5396	nmi	miles	1.1516
km/hr	ft/sec	0.9113	ounces	grams	28.34953
km/hr	knots	0.5396	pounds	kg	0.4536
km/hr	miles/hr	0.6214	psi	kg/cm^2	0.0703
knots	ft/sec	1.689	100 ft	km	3.048
knots	km/hr	1.8532	100 ft	miles	1.894
knots	miles/hr	1.1516	100 ft	nmi	1.645

THIS PAGE INTENTIONALLY LEFT BLANK.

APPENDIX D - ABBREVIATIONS

A

AC	Alternating Current
ac	Alternating Current
ADF	Automatic Direction Finder
AFC	Automatic Frequency Control
AM	Amplitude Modulated
AMPL	Amplifier
ANLYZER	Spectrum Analyzer
ARINC	Aeronautical Radio, Inc.
ASCII	American Standard Code for Information Interchange
ATE	Automatic Test Equipment
ATTEN	Attenuation
AUX	Auxiliary

B

BCD	Binary Coded Decimal

C

ccw	Counterclockwise
cm	Centimeter
CMOS	Complementary Metal-Oxide Semiconductor
CONT	Control
Cont	Continued
CW	Continuous Wave
cw	Clockwise

D

D/A	Digital to Analog
dB	Decibel
dBc	Decibels relative to carrier
dBi	Decibels above isotropic
dBm	Decibels above one milliwatt
dc	Direct Current
DET	Detector
Div	Division
DLYD	Delayed
DMM	Digital Multimeter
DSCRM	Discriminator

E

EFF	Effective
EXT	External
Ext	External

F

FCC	Federal Communications Commission
FM	Frequency Modulated
FREQ	Frequency
Ft	Feet

G

GEN	Generator
GHz	Gigahertz (10^9)
GND	Ground

H

h	Hexadecimal
HET	Heterodyne
HI	High
hr	Hour
Hz	Hertz

I

IEEE	Institute of Electrical and Electronic Engineers
IF	Intermediate Frequency
INTL	Internal
I/O	Input/Output

K

kg	Kilograms (10^3)
kHz	Kilohertz (10^3)
km	Kilometers (10^3)
kts	Knots (Velocity)
kV	Kilovolts (10^3)
kW	Kilowatts (10^3)

L

LED	Light Emitting Diode
LO	Local Oscillator
LO	Low (Controls)
LRU	Line Repairable Unit

M	
m	Meters
Max	Maximum
MDR	Minimum Detectable Range
MDS	Minimum Discernible Signal
MHz	Megahertz (10^6)
Min	Minimum
MKR	Marker
MNL	Manual
MOD	Modulator
MON	Monitor
ms	Milliseconds (10^{-3})
mV	Millivolt (10^{-3})
N	
N/A	Not Applicable
NM	Nautical Miles
nmi	Nautical Miles
ns	Nanoseconds (10^{-9})
O	
OSC	Oscillator
P	
PC	Printed Circuit
PM	Pulse Modulated
PPM	Pulse Position Modulated
PRF	Pulse Repetition Frequency
psi	Pounds per Square Inch
PWM	Pulse Width Modulated
PWR	Power
R	
RCT	Rain Echo Attenuation Compensation Technique
RCV	Receive
RCVR	Receiver
Ref	Reference
RF	Radio Frequency
RMS	Root Mean Square
R/T	Receiver/Transmitter
RTCA	Radio Technical Commission for Aeronautics
S	
SCOPE	Oscilloscope
SCP	Oscilloscope
sec	Seconds
SEL	Select
S/N	Serial Number
STC	Sensitivity Time Control
SWP	Sweep
SYNC	Synchronization
T	
TGS	Tangential Sensitivity Signal
TRIG	Trigger
TTL	Transistor-Transistor Logic
U	
UUT	Unit Under Test
V	
V	Volts
VAC	Volts, Alternating Current
VCO	Voltage Controlled Oscillator
Vdc	Volts, Direct Current
V_{dcP}	Volts, Peak Direct Current
VHF	Very High Frequency
V_P	Volts, Peak
V_{P-P}	Volts, Peak-to-Peak
VSWR	Voltage Standing Wave Ratio
W	
W	Watts
X	
XCVR	Transceiver
XMTR	Transmitter
µs	Microseconds (10^{-6})

INDEX

Title	Chapter/Section/Subject	Page
Abbreviations	Appendix D	1
Automatic Frequency Control (AFC)		
Alignment	1-2-4	16
Centering	1-2-4	10
Composite	1-1-1	3
Connector Pin-Out Table	Appendix A	1
Controls, Connectors and Indicators	1-2-2	2
Description	1-1	
Description of Controls, Connectors and Indicators	1-2-2	2
RD-301A Front and Rear Panels	1-2-2	2
Discriminator Pulse		
Operation	1-2-4	13
Specification	1-3-1	4
Dual Target Simulation	1-2-4	8
Effective Power		
Operation	1-2-4	10
Performance Evaluation	1-2-3	10
External AM		
Description	1-2-2	13
Operation	1-2-4	7
Specifications	1-3-1	3
Frequency		
Counter	1-3-1	3
Display	1-2-2	3
IF		
Operation	1-2-4	18
Performance Evaluation	1-2-3	3
Specifications	1-3-1	2
PRF		
Performance Evaluation	1-2-3	4
Specifications	1-3-1	3
RF		
Performance Evaluation	1-2-3	2
Specifications	1-3-1	1
UUT	1-2-4	4
Functional Capabilities	1-1-1	1
General Description and Capabilities	1-1-1	1
General Operating Procedures	1-2-4	1
Heterodyne Monitor		
Operation	1-2-4	14
Performance Evaluation	1-2-3	9

Title	Chapter/Section/Subject	Page
IF		
Operation	1-2-4	18
Performance Evaluation	1-2-3	3
Specifications	1-3-1	2
Installation	1-2-1	1
Intensity Levels	1-2-4	6
Internal AM		
Operation	1-2-4	7
Specifications	1-3-1	2
Magnetron Pulse Frequency and Phase Deviation	1-2-4	13
Marker		
Operation	1-2-4	19
Performance Evaluation	1-2-3	13
Specifications	1-3-1	2
Mechanical Description	1-1-1	2
Meter Function		
Description	1-2-2	11
Performance Evaluation	1-2-3	8
Specifications	1-3-1	4
Metric/British Imperial Conversion Table with Nautical Distance Conversions	Appendix C	1
Minimum Detectable Range (MDR)	1-2-4	11
Minimum Discernible Signal	1-2-4	6
Operating Precautions	1-2-4	1
Operation	1-2	
Peak Power		
Operation	1-2-4	4, 10
Performance Evaluation	1-2-3	8
Performance Evaluation	1-2-3	1
Performance Evaluation Data Sheet	1-2-3	14
Performance Evaluation Procedures	1-2-3	2
Power Meter		
Performance Evaluation	1-2-3	8
Specifications	1-3-1	4
Power Percentage, UUT	1-2-4	20
Power Requirements	1-2-1	2
	1-3-1	4
Power-Up Procedure	1-2-1	2
PRF		
Performance Evaluation	1-2-3	4
Specifications	1-3-1	3
Pulse Width		
Radar UUT Transmitter Pulse	1-2-4	17
Reply Pulse		
IF	1-3-1	2
Performance Evaluation	1-2-3	6
RF	1-3-1	1

Title	Chapter/Section/Subject	Page
R1,R2 AUTO	1-2-3	11
Radar UUT Transmitter Pulse Width	1-2-4	17
Radar UUT Transmitter Pulse Comparison	1-2-4	17
Range		
Operation	1-2-4	5
Performance Evaluation	1-2-3	5
Specifications	1-3-1	3
Rack-Mount Installation	1-2-1	2
Receiver Selectivity	1-2-4	19
Repacking Procedure	1-4-1	1
RF		
Performance Evaluation	1-2-3	2
Specifications	1-3-1	1
Safety Precautions	1-2-1	1
Sensitivity	1-2-4	6
Sensitivity Time Control (STC)	1-2-4	12
Shipping	1-4	
Shipping Information	1-4-1	1
Specifications	1-3	
Storage	1-5	
Sweep Width		
Operation	1-2-4	19
Specification	1-3-1	2
Test Equipment Requirements	Appendix B	1
Test Setup	1-2-4	2
Tracking		
Performance Evaluation	1-2-3	10
Specifications	1-3-1	1
Turbulence Detection	1-2-4	7

THIS PAGE INTENTIONALLY LEFT BLANK.

CUSTOMER RECOMMENDED CHANGES TO TECHNICAL MANUALS

CUSTOMER INFORMATION

NAME (PLEASE PRINT) DATE

YOUR TITLE BUSINESS PHONE #

COMPANY NAME

BUSINESS ADDRESS

CITY STATE ZIP

PRODUCT INFORMATION

MODEL # SERIAL #

MANUAL TYPE

- ☐ OPERATOR'S GUIDE
- ☐ OPERATION MANUAL
- ☐ MAINTENANCE MANUAL
- ☐ ILLUSTRATED PARTS LIST

PUBLICATION DATE_____

PLEASE BE SPECIFIC IN IDENTIFYING PROBLEMS

PAGE NO.	PARA. NO.	FIGURE NO.	TABLE NO.	COMMENTS

MAIL TO ADDRESS ON REVERSE

PLACE
STAMP
HERE

IFR SYSTEMS, Inc.
10200 West York Street
Wichita, Kansas 67215

ATTEN: TECHNICAL PUBLICATIONS

SECTION 5 - STORAGE

1. General

The following storage precautions should be accomplished whenever Test Set is stored for extended periods:

- Disconnect Test Set from power source.
- Disconnect and store ac power cable and accessories with Test Set.
- Cover Test Set to prevent dust and debris from covering and entering Test Set.

THIS PAGE INTENTIONALLY LEFT BLANK.

MP MASTER
MA30543